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Silviculture Specialist's Report

Landscape Vegetation Analysis

Brush Creek Hayden and Laramie Ranger Districts

Medicine Bow-Routt National Forests & Thunder Basin National Grassland

Albany and Carbon Counties, Wyoming

T.12 - 19N, R.77 - 89W, 6th Principle Meridian

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Silviculture Forester

Laramie Ranger District, Medicine-Bow National Forest

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Medicine-Bow National Forest Land Management Plan Direction

Forest-wide Standards and Guidelines

Forest-wide standards and guidelines apply to all areas of the Medicine Bow National Forest. Standards and guidelines are often more general in nature than the desired future conditions (DFC's). Standards are intended to be closely adhered to during implementation, while the guidelines are intended to be more flexible, establishing parameters rather than rigid requirements. (See Forest Plan Chapters 1-3)

Forest-Wide Standards and Guidelines for Vegetation- No Action

The no action alternative is consistent with all Forest-Wide Standards for Vegetation except: (MA 5.15) Manage vegetation to maintain or restore healthy ecological conditions through a variety of management activities. Timber harvest is scheduled and does contribute to the allowable sale quantity. There are opportunities to collect firewood. The no action alternative is inconsistent with Forest Plan Guidelines: (MA 1.31, 1.33) Allow the cutting or removal of trees under circumstances such as; to reduce fuel load and fire risk, especially adjacent to private land; to curtail imminent threat of insect attack; enhancing a scenic view from a prominent overlook, to maintain wildlife habitat diversity or maintenance of existing facilities; (MA 5.13) Manage stands using treatments, which maintain acceptable rates of growth as well as favor commercially valuable tree species; Use a full range of biologically appropriate silvicultural practices to produce sawtimber and other forest products; (MA 8.6) Vegetation should be managed to reduce the risk of loss to administrative facilities from catastrophic fires.

Forest-Wide Standards and Guidelines for Vegetation- Final Proposed Action

Standard and Guideline	Forest Plan Direction	Project Summary
Biological Diversity	Manage old forest to retain or achieve at least the minimum percentages of old growth by cover type by mountain range shown in the following table. If stands meeting the old growth definition do not exist at these percentages, manage additional stands that are closest to meeting old growth criteria as recruitment old growth to meet these desired percentages. [Medicine Bow NF] Limit management of stands to actions necessary to maintain or restore old growth composition and structure. **(Standard, p. 1-31)** Identify and map old growth blocks that mimic natural patch size and distribution. Include non-linear, unfragmented blocks (over 300 acres) where available. Old growth in small, scattered stands, larger patches, and streamside stretches shall be maintained to produce a pattern that is well distributed across the landscape by making sure that some old growth is maintained in every Geographic Area. Consider connectivity when identifying scattered stands. **(Guideline, p. 1-31)**	Activities under the LAVA project will maintain the required levels of old growth required by the Forest Plan.
Biological Diversity	Operations (such as timber harvest and other vegetative treatments) and road and motorized trail construction and management should be conducted to create patch sizes of sufficient area or appropriate spatial pattern to serve the habitat needs of species or communities at risk. **(Guideline, p. 1-31)**	Habitat needs of species or communities at risk are address through specific design Criteria if they occur in the project area. Complies with Forest Plan Standards and Guides.

Standard and Guideline	Forest Plan Direction	Project Summary
Biological Diversity: Siliviculture	When managing vegetation, maintain existing, or move towards desired patch size, distribution, abundance and/or edge-to-interior ratios, which are characteristic of natural disturbances (fire, insects, and diseases) representative of the cover types, measured at the Geographic Area scale. **(Guideline, p. 1-32)**	The design of the units in irregular shapes and sizes imitates characteristics of natural disturbances. Units will be designed to follow natural breaks in the landscape such as topographic features and vegetation differentiation boundaries. Some boundaries may follow road ways. Complies with Forest Plan Standards and Guides.
Biological Diversity: Siliviculture	Use a 40 –acre maximum size for openings created by even-aged management, regardless of forest type, with the following exceptions: Where larger openings are the result of natural catastrophic condition of fire, insect or disease attack, or windthrow. **(Standard, p. 1-35)**	Areas affected by the bark beetle epidemic are an exception to the 40 acre maximum size. Areas that are not affected or minimally affected by the bark beetle epidemic will follow the 40 acre maximum size.
Biological Diversity: Siliviculture	Appropriate silvicultural systems by forest cover type will be: Cover Type — Silvicultural System Ponderosa Pine/ Mixed Conifer — Shelterwood, Clearcut Seed tree, Irregular Shelterwood, Group Selection, Single-tree selection Lodgepole pine — Clearcut, Shelterwood, Group Selection, Seed tree, Irregular Shelterwood Engelmann Spruce / Subalpine Fir — Shelterwood, irregular Shelterwood Group Selection, Single-tree Selection Aspen — Coppice, Coppice	Treatments For the LAVA project will follow the silvicultural systems for each cover type as described in the Forest Plan. Complies with Forest Plan Standards and Guides.

Standard and Guideline	Forest Plan Direction	Project Summary
	With Standards, Group Selection **(Standard 2,p. 1-36)**	
Biological Diversity: Siliviculture	No minimum seedling height requirements are specified. Seedlings must have survived a minimum of 1 year and be expected (on the basis of research and experience) to be able to produce the desired future stand condition specified for the area in the forest plan. The number of seedlings in the following table represents the minimum number of seedlings required, considering natural mortality, to produce a merchantable timber stand at rotation age without intermediate treatments. [R2 Desk Guide] Conifers 150 TPA Hardwoods 300TPA **(Standard 3,p. 1-36)**	Treatment areas will be monitored to ensure they meet Forest Plan stocking standards within 5 years after treatment. If the treated areas do not meet Forest plan stocking standards within 5 years a plan will be developed and implemented to ensure the treated areas meet stocking standards. Site preparation activities, regeneration surveys and planting of seedlings could be used to ensure required reforestation is met.
Biological Diversity: Siliviculture	When trees are to be harvested on other than suitable lands, exceptions to the 5-year restocking standard are appropriate as documented in project decisions when the harvest meets one of the following criteria: [R2 Desk Guide] a. For permanent openings that serve specific management direction. b. Where provided for in specific management practices and prescriptions. c. Where it is desirable to delay regeneration and crown closure to meet specific desired conditions and management objectives. **(Standard 4, p.1-37)**	Treatments designed to meet objectives other than timber production on other than suitable lands, such as enhance wildlife habitat, may not meet 5 year stocking standards. However most treated areas are expected to meet the 5 year restocking standard. Complies with Forest Plan Standards and Guides.
Biological Diversity: Siliviculture	Timber harvest units will be designed to retain snags and snag recruitments according to Forest Plan Table 1-11. Retained snags and snag recruits are designated as wildlife trees and will be left on site if blown over. **(Standard 5, p. 1-37)**	Table 1-11 of the forest plan states b) When using prescribed fire, and in treatments to reduce fuel in urban interface areas, it will be acceptable that snag retention and snag recruitment standards may not be met. Areas adjacent to treatment units will provide abundant snags. Treatments within WUI areas do not have to meet this standard. Outside of WUI areas

Standard and Guideline	Forest Plan Direction	Project Summary
		guidance for snag recruits and retention will be followed.
Biological Diversity: Siliviculture	Final timber harvest units will be designed to retain coarse woody debris well distributed in accordance with the ranges specified in the following table. Unmerchantable trees should be left standing to replace downed wood that is expected to be lost during site preparation treatment or if existing material does not meet the desired tonnage. [Medicine Bow NF] **(Standard 6 p. 1-38)**	Table 1-12 of the forest plan states When using prescribed fire, and in treatments to reduce fuel in urban interface areas, it will be acceptable that coarse woody debris standards may not be met. Treatment units within WUI areas do not have to meet this standard. Outside of WUI areas coarse woody debris will be left according to this standard. Complies with Forest Plan Standards and Guides.
Biological Diversity: Siliviculture	The design of a silviculture treatment should emulate the pattern and frequency of natural disturbances found in the landscape being treated. **(Guideline, p. 1-39)**	The size and shape of units will be designed to emulate the historic range of disturbances across the landscape.
Biological Diversity: Siliviculture	Regeneration harvests of even-aged timber stands should not be undertaken until the stands have generally reached or surpassed 95% culmination of the mean annual increment (CMAI) measured in cubic feet. Exceptions may be made where resource management objectives or special resource considerations require earlier harvest, such as: [R2 Desk Guide] a. Stands that are in imminent danger from insect or disease attack/mortality. b. Wildlife habitat improvement. c. Scenery resource enhancement or rehabilitation. d. Ecosystem restoration. e. Areas managed for Christmas tree production. f. Where other resource management objectives or special resource considerations would	Regeneration harvest in stands that are not affected by insect and disease activity will not take place unless stands have reached or surpassed 95% culmination of the mean annual increment. In stands that are affected by insect and disease or within wildland urban interface areas this standard does not apply. Complies with Forest Plan Standards and Guides.

Standard and Guideline	Forest Plan Direction	Project Summary
	benefit from earlier harvest. **(Guideline, p. 1-39)**	
Biological Diversity: Siliviculture	Reduce activity fuels resulting from all projects/activities to acceptable levels in a cost effective manner, in consideration of soil protection and wildlife habitat needs for retention of downed wood. [Medicine Bow NF] **(Guideline 3, p. 1-40)**	Residual fuels resulting from management activities will be treated based upon the silvicultural prescription, which includes considerations for soil protections, wildlife habitat needs and WUI concerns. Complies with Forest Plan Standards and Guides.
Biological Diversity: Insects and Disease	Use integrated pest management techniques, including silviculture treatments, to meet management area objectives. Base treatments activities on achieving multiple use and ecosystem management objectives and reducing risks to adjacent private and public lands. Give priority to areas in which values to be protected exceed cost of protection; for example, areas adjacent to subdivisions, recreation sites, suitable timberlands, or areas of concentrated public use. **(Guideline 1, p. 1-50)**	The purpose of the project is to enhance forest resiliency, provide for human safety, provide for protection of infrastructure, municipal water supplies and TES habitat, and mitigate hazardous fuel loading. During these treatments trees will be removed according to silvicultural prescriptions that address the measures to mitigate the spread of insect and diseases. Complies with Forest Plan Standards and Guides.
Biological Diversity: Insects and Disease	Use vegetation management practices to meet objectives and reduce risk of insects and disease. Give priority to cover types identified as moderate to high risk. **(Guideline 2, p. 1-50**	Most areas within the project have experienced epidemic levels of insect infestation. Complies with Forest Plan Standards and Guides.
Biological Diversity: Insects and Disease	In project plans, consider existing infestations of insects or disease within the project area. Design activities to minimize risk of spreading infestation and meet multiple use and ecological objectives. **(Guideline 3, p. 1-50)**	The purpose of the project is to enhance forest resiliency, provide for human safety, provide for protection of infrastructure, municipal water supplies and TES habitat, and mitigate hazardous fuel loading. During these treatments trees will be removed according to silvicultural prescriptions that address the measures to mitigate the spread of insect and diseases. Complies with Forest Plan Standards and Guides.

Management Areas

Desired Future Conditions

Desired Future Conditions (DFC's) describe land management direction intended to accomplish the Goals and Objectives. Descriptions of the management areas can be found in the Medicine Bow National Forest Revised Land and Resource Management Plan chapter 3. Duplicated general Forest Plan guidance and Management Area direction are addressed in the Forest Plan guidance section.

Applicable DFC Direction for Vegetation

MA	Forest Plan Direction	Project Summary
1.31, 1.33,1.5, 2.1, 3.31, 3.33, 3.4, 3.54, 3.56, 4.2, 4.3, 8.21, 8.22, 8.6	Use only vegetation management practices necessary to meet specific resource objectives other than wood production. Timber harvest is not scheduled and does not contribute to the allowable sale quantity.	Within these areas harvest activities will be completed to meet multiple objectives as stated in the purpose and need for the project.
1.31	Reclaim disturbed lands to a condition suitable for the purposes for which the area was identified.	Vegetation management will provide the opportunity for growth of existing understory and natural regeneration to occur quicker allowing the area to more quickly return to the desired condition.
1.31 1.33 3.31 3.54	Allow the cutting or removal of trees under circumstances such as; to reduce fuel load and fire risk, especially adjacent to private land; to curtail imminent threat of insect attack; enhancing a scenic view from a prominent overlook, to maintain wildlife habitat diversity or maintenance of existing facilities	The project addresses the specific circumstances allowed for in the Forest Plan.
2.1	Protect and manage values for which the SIA was identified (e.g., biological, geological, historical, paleontological, etc.).	During implementation of the project design features will be used to protect SIA values.
3.31	Conduct management activates to simulate natural vegetation patterns and patch size	Historic range of variation for the MBR suggests that there were varying patch sizes and structure across the landscape due to disturbance. Treatments will create patches of varying size and structure.

3.33	Use vegetative management practices, usually to meet specific recreation and wildlife objectives, which generally maintain a mature forest appearance. Use timber harvest to prevent or respond to epidemic insect conditions which could threaten resource objectives within or adjacent to the management area.	This project is responding to the effects from bark beetle epidemics. Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
3.4	Allow, through natural processes and succession, or encourage through vegetation treatments, the development of lodgepole pine and spruce-fir forest to provide diversity of forest habitats.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
3.5	Allow natural outbreaks of native insects and diseases to proceed without intervention, unless they are a substantial threat to important resources inside or adjacent to the management area boundary.	Bark beetle outbreaks have caused forested conditions that if fire were to occur, could threaten important resources.
3.5, 5.15	Design and implement silvicultural treatments to meet wildlife objectives for vertical structure, stand density, age class distribution, spatial pattern, or other habitat goals.	The LAVA project has the objectives of increasing forest resilience and protection of habitat for threatened and endangered species. Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
3.5, 5.15	In areas burned by wildfire, provide habitat for post fire animal and plant communities in the design of salvage sales. Consider the historic levels of post burn habitat and the role of this habitat at various intervals following the fire.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
3.5	Limit vegetation treatment in inventoried and mapped spruce-fir or lodgepole pine old growth stands.	Activities under the LAVA project will maintain the required levels of old growth required by the Forest Plan. Vegetation management in old growth stands will follow Forest Plan Guidance see Old Growth section pg 24 below.
3.56	Conduct aspen management activities in the most economically efficient manner.	Treatment of aspen will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives in the most economical manner.
3.58, 5.41	Restrict intensive management activities such as timber harvest or road construction during the winter and spring periods (November 15-April 30) where conflicts with wintering wildlife are identified. 5.41 Except for habitat improvement.	Specific restrictions for each project will be determined prior to implementation. Restriction will be implemented as required by the line officer.
3.58	Allow uses and activities only if they do not degrade the characteristics for which the area was designated.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.

3.58	Design activities to maintain or improve habitat.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
3.58	Timber harvest is not scheduled and does not contribute to the allowable sale quantity.	Lava projects will be in areas assigned to ASQ and areas where ASQ is not assigned.
3.58	Design changes in tree cover such that new stands will provide good quality cover consistent with the capability of sites.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
4.2	Focus pest management activities and methods on enhancing or protecting the scenic quality of the area.	Disturbance and tree removal during timber harvests will allow sites to regenerate quicker than non-managed sites and more quickly return the area to greater scenic quality.
4.3	Focus pest management activities and methods on enhancing or protecting recreation opportunities.	Timber harvests will be used to remove hazardous trees, caused by insect infestation, from in and around managed recreation areas and known dispersed recreation use areas.
5.12, 5.13	Use a full range of biologically appropriate silvicultural practices to produce sawtimber and other forest products. Timber harvest is scheduled and does contribute to the allowable sale quantity. Opportunities are provided to collect firewood.	Multiple silvicultural practices are proposed to meet the objectives of the LAVA project which include commercial products. Opportunities for public firewood gathering will be determined during implementation of the project.
5.12	Cut or remove trees to reduce fuel loads and fire risk, especially adjacent to private lands.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
5.13 **8.6**	Manage forested areas such that insect infestations and disease outbreaks remain locally restricted.	Treatments conducted under the LAVA project will provide current and future opportunities to manage for these concerns.
5.13	On lands suitable for timber production, manage to produce sawtimber-size trees in an economically efficient manner.	Treatments will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives in the most economical manner.
5.13	Produce multiple wood products, including posts, poles, Christmas trees, and fuelwood, in an economically efficient manner through appropriate silvicultural practices.	Treatments will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives in the most economical manner.
5.13	Manage stands using treatments, which maintain acceptable rates of growth as well as favor commercially valuable tree species.	Treatments will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives.

5.15	Manage forested area such that insect infestations and disease outbreaks remain locally restricted, except where compatible with site-specific management objectives and conditions.	Treatments conducted under the LAVA project will provide current and future opportunities to manage for these concerns.
5.15	Manage vegetation to maintain or restore healthy ecological conditions through a variety of management activities. Timber harvest is scheduled and does contribute to the allowable sale quantity. There are opportunities to collect firewood.	Treatments will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives. Opportunities for public firewood gathering will be determined during implementation of the project. Removal of timber will count toward the forest ASQ.
5.15	Prohibit vegetation treatment in inventoried and mapped spruce-fir or lodgepole pine old growth stands.	Identified old growth areas in management area 5.15 are not part of this project
5.15	Mimic the size, shape, juxtaposition, and position on the landscape of past fires. Sizes of openings can vary from a few acres up to 250 acres based on site-specific conditions. Inclusion of past harvest units will be evaluated for opportunities to restore natural patterns on the landscape.	The design of the units in irregular shapes and sizes mimics conditions found after natural disturbance.
5.15	Design boundaries of harvest units to mimic natural landscape patterns.	The design of the units in irregular shapes and sizes mimics conditions found after natural disturbance.
5.15	Favor broadcast burning over mechanical treatments to complete site preparation.	The site preparation technique used will be determine post vegetation management and be selected to achieve the desired objectives of the treatment and the technique most likely to ensure adequate restocking of seedlings.
5.15	Design precommercial thinning treatments to emulate natural variability in tree spacing	A variety of thinning techniques which include variability of spacing will be used.
5.15	In clearcut units, retain approximately 20% of the interior of the unit in clumps, or fingers of unharvested trees. These areas contribute to forest-wide standards for snag retention and distribution of future downed wood. These interior units are designed to emulate unburned areas that occur in natural fire disturbances.	Retention areas will be used outside of WUI areas and where there are not current insect and disease concerns.
5.15	Special emphasis is given to treating lodgepole pine in the 80 to 120 age class where these ages exceed the HRV. This may require harvesting some stands prior to achievement of 95% Culmination of Mean Annual Increment (CMAI) as described in 36 CFR 219.16(a)(3)(iii).	Treatment areas will be selected and a variety of treatment types will be conducted to achieve the desired treatment objectives. In stands that are affected by insect and disease or within wildland urban interface 95% CMAI is not required.

5.15	Use a full range of biologically appropriate silvicultural practices to produce sawtimber and other forest products	Treatments will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives.
5.41	Use only vegetation management practices necessary to meet specific resource objectives. Timber harvest is not scheduled and does not contribute to the allowable sale quantity.	Treatments will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives.
5.41	Focus vegetation management on meeting wildlife winter range habitat objectives.	Treatments will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives.
5.42	Implement vegetation management practices that maintain or improve bighorn sheep habitat. Timber harvest is not scheduled and does not contribute to the allowable sale quantity.	Treatments will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives.
5.42	Avoid vegetation management activities between November 15 and April 30th unless the treatments are needed to enhance habitat and cannot be completed outside these dates.	Specific restrictions for each project will be determined prior to implementation. Restriction will be implemented as required by the line officer.
7.1	Coordinate management activities with adjacent landowners, county fire wardens, local volunteer fire departments, and the Sate Forester	The Lava project is being designed and will be implemented in conjunction with multiple stakeholders.
7.1, 8.22	Minimize potential for insect infestations and disease outbreaks through vegetation treatments to maintain stands at moderate or lower risk.	Treatments conducted under the LAVA project will provide current and future opportunities to manage for these concerns.
8.21	Focus pest management activities and methods on enhancing or protecting site vegetation and facilities.	Vegetation management will be used to remove hazardous trees caused by insect infestation from in and around managed recreation areas.
8.6	Manage forested areas such that insect infestations and disease outbreaks remain locally restricted.	Treatments conducted under the LAVA project will provide current and future opportunities to manage for these concerns.
8.6	Vegetation should be managed to reduce the risk of loss to administrative facilities from catastrophic fires.	Treatments will be conducted using a variety of tools; prescribed fire and tree cutting; to achieve the desired treatment objectives.

Geographic Areas

Geographic Areas (GA) help recognize interactions between management area prescriptions and monitor the effects of management activities, locally and forest-wide. Aggregation of management area prescriptions to the geographic area level ties land management activities to the landscape scale. GA desired conditions are based on the unique combination of ecological and social processes inherent to the defined area. The direction needed to respond to these unique conditions is provided in the GA

desired condition and GA guidelines sections. Application of the management area prescriptions and associated standards and guidelines will move specific portions of each GA towards the desired condition.

Applicable Standards and Guidelines for Vegetation Management

Sierra Madre Range

GA	Forest Plan Direction	Project Summary
Beaver Creek, Encampment River	Maintain or enhance fire-dependent species such as aspen, ponderosa pine, and Douglas-fir.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
Encampment River	Ensure multiple use management of the North Fork Encampment River watershed is compatible with protection of domestic eater supply needs.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
Northeast Sierra Madre	Maintain or enhance aspen and Douglas-fir	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
North Savery, South Savery	Maintain or enhance fire-dependent species (aspen, ponderosa pine, Gambel oak, and Douglas-fir.) and unique riparian species (blue spruce and narrowleaf cottonwood)	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
Upper Little Snake River	Maintain and enhance fire-dependent species such as aspen and Gambel oak	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.

Snowy Range

DFC	Forest Plan Direction	Project Summary
Barret, Bow River, Pass Creek, Pennock Mountain, Platte River	Maintain or enhance fire-dependent species such as aspen, ponderosa pine, and Douglas-fir.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.

Barret, Bow River, Brush Creek, French Creek, Middle Fork, North Fork, Platte River, Upper Douglas Creek	Consider bighorn sheep management needs when conducting vegetation treatments	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
Brush Creek	Maintain or enhance fire-dependent species (aspen and Douglas-fir.) and unique riparian species (blue spruce and narrowleaf cottonwood)	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
French Creek	Maintain and enhance the historical ranges within French Creek Canyon for fire-dependent species (aspen, ponderosa pine, and Douglas-fir) and unique riparian species (narrowleaf cottonwood and blue spruce).	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
Lower Douglas Creek	Ensure that all management activities within the proclaimed Sheep Mountain Game Refuge boundary are consistent with guidance described in the proclamation.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
Snowy Range Eastern Front	Maintain or enhance fire-dependent species such as aspen and Douglas-fir.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.
Upper Douglas Creek	Maintain or enhance fire-dependent species such as aspen.	Specific objectives for each project will be determined prior to implementation and treatments will be conducted to achieve these objectives.

ANALYSIS METHODOLOGY

This analysis was conducted using the Forest Service FSVegspatial data layer in which contains information about each stand within the analysis. Stand information includes cover type, tree size, habitat structural stage and many other feature is stored at the stand level. FSVegspatial was updated in 2015 using computer modeling to capture the effects of recent bark beetle epidemics. (RSAC 2015) process. It is important to note that the FSVegspatial layer does not take into account insects and disease that did not affect the canopy but would otherwise affect the timber resource and the management options that would be considered for stands.

Canopy Cover Change

Looking at the stand in terms of change to canopy cover demonstrates the effects of disturbance agents and the potential effects to a stand better than just mortality. Mortality in a stand implies the change to canopy cover but does not correlate to the loss of canopy. The greater the loss of canopy the more likely species, such as grass/forbs and lodgepole pine seedlings that need exposed environments to germinate will be present. Intermediate conditions that provide both sun and shade favor more shade tolerant species such as sub alpine fir. This change is not the equivalent of the mortality experienced in the stand. For example a stand that was 100% alive prior to disturbance with a live canopy cover of 70% and after the disturbance was 60% live with a live canopy cover of 30% would have experienced a 58% change in canopy cover. Three categories of change where developed based upon the effects the amount of change to the canopy would simulate. A change of 50% or greater suggests that a stand is in the stand initiation phase. A change of 30%-49% suggests that a stand is still viable and would need intermediate treatments. A change of less than 30% suggest that a stand was minimally affected by disturbance agents and available for green tree treatment types. Within the Lava project approximately 75,703 acres has experienced a canopy cover change of ≥ 50%, 136,862 acres of 30%-49% canopy cover change, and 283,454 acres of 0-29% canopy cover change.

Table 1: Canpoy Cover Change by Analysis Unit

	Acres of Canopy Change		
Analysis Unit	≥ 50%	30%-49%	<30%
Battle Pass	594	4,594	15,372
Big Blackhall	10,408	12,032	15,675
Bow Kettle	4,507	10,314	23,692
Cedar Brush	2,336	10,228	22,853
Fox Wood	14,630	15,937	34,077
French Douglas	5,387	8,440	23,941
Green Hog	3,780	8,103	15,454
Jack Savery	4,748	19,118	31,460
North Corner	7,202	8,317	10,550
Owen Sheep	3,615	3,777	6,139
Pelton Platte	4,481	4,050	6,439
Rock Morgan	2,972	10,098	19,459
Sandy Battle	3,922	8,923	32,765
West French	7,121	12,931	25,576

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Affected Environment _____

Existing Vegetation

Ranging in elevation from approximately 7,000’ to 12,000’ the Landscape Vegetation Analysis Project Area (PA) is predominantly timbered with open grass meadows. Past disturbances including fire, natural succession, wind throw, insect and disease, and vegetation management are primarily responsible for the vegetation patterns within the PA. Primary forest vegetation cover types occurring in the PA include lodgepole pine (*Pinus contorta*), Ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), aspen (*Populus tremuloides*), limber pine (*Pinus flexilis*) grass, forbs, shrubs, and willow (*Salix spp.*). These plant communities are

segregated along gradients of elevation and topography, which directly affect important plant growth determinants such as temperature, effective precipitation and hydrologic regime.

Cover Types

All cover types on the Medicine Bow Routt are associated with this project. The main cover types concerning the timber resource, which will be the most affected by this project, are spruce/fir, lodgepole pine, aspen, and mixed conifer. The life cycles of species will not be discussed in this analysis. However this information can be found in the Silvics of North America Volume 1 and 2, Agricultural Handbook No. 654. The acreage and size class distribution of each cover type is available in table 2.

Table 2: Existing Dominat Species by Mountian Range (FSVeg)

Sierra Madre

FSVeg Species	ALL	Established	Small	Medium	Large	Very Large	% of Mountain range
Forbs/ Grasses	135680						34
Barren	4044						1
Shrub	10810	0	428	4456	5926	0	3
Aspen	54869	1444	1980	33446	17914	85	14
Ponderosa pine (PP)	0						0
Douglas-fir (DF)	730			8	591	131	0
Lodgepole pine (LP)	132682	6826	11129	56250	58127	350	33
Spruce-fir (SF)	61102	3208	824	9362	44784	2924	15
Limber pine (LM)	56				56		0
Cottonwood	202			43	159		0

1–Established = < 1”dbh, Small = 1-4.9”dbh, Medium = 5-8.9”dbh, Large = 9-15.9”dbh, very large = > 16”dbh

2- acres shown are for NFS land only

Snowy Range

FSVeg Species	ALL	Established	Small	Medium	Large	Very Large	% of Mountain Range
Forbs/ Grasses	131743						23
Barren	4344						1
Shrub	3811		2640	977	194		1
Willow	13523		94	12470	959		2
Aspen	22916	704	2867	10925	8414	6	4
Ponderosa pine (PP)	162				19	143	0
Douglas-fir (DF)	6476	243		2693	3143	397	1
Lodgepole pine (LP)	269957	16067	52682	113848	86447	913	47
Spruce-fir (SF)	120223	6429	9850	20993	71038	11913	21
Limber pine (LM)	957		22	157	676	102	0
Rocky MTN Juniper	33			33			0
Cottonwood	255			53	69	133	0

1–Established = < 1”dbh, Small = 1-4.9”dbh, Medium = 5-8.9”dbh, Large = 9-15.9”dbh, very large = > 16”dbh

2- acres shown are for NFS land only

Figure 1: Major Treed Cover Types Of the Sierra Madre

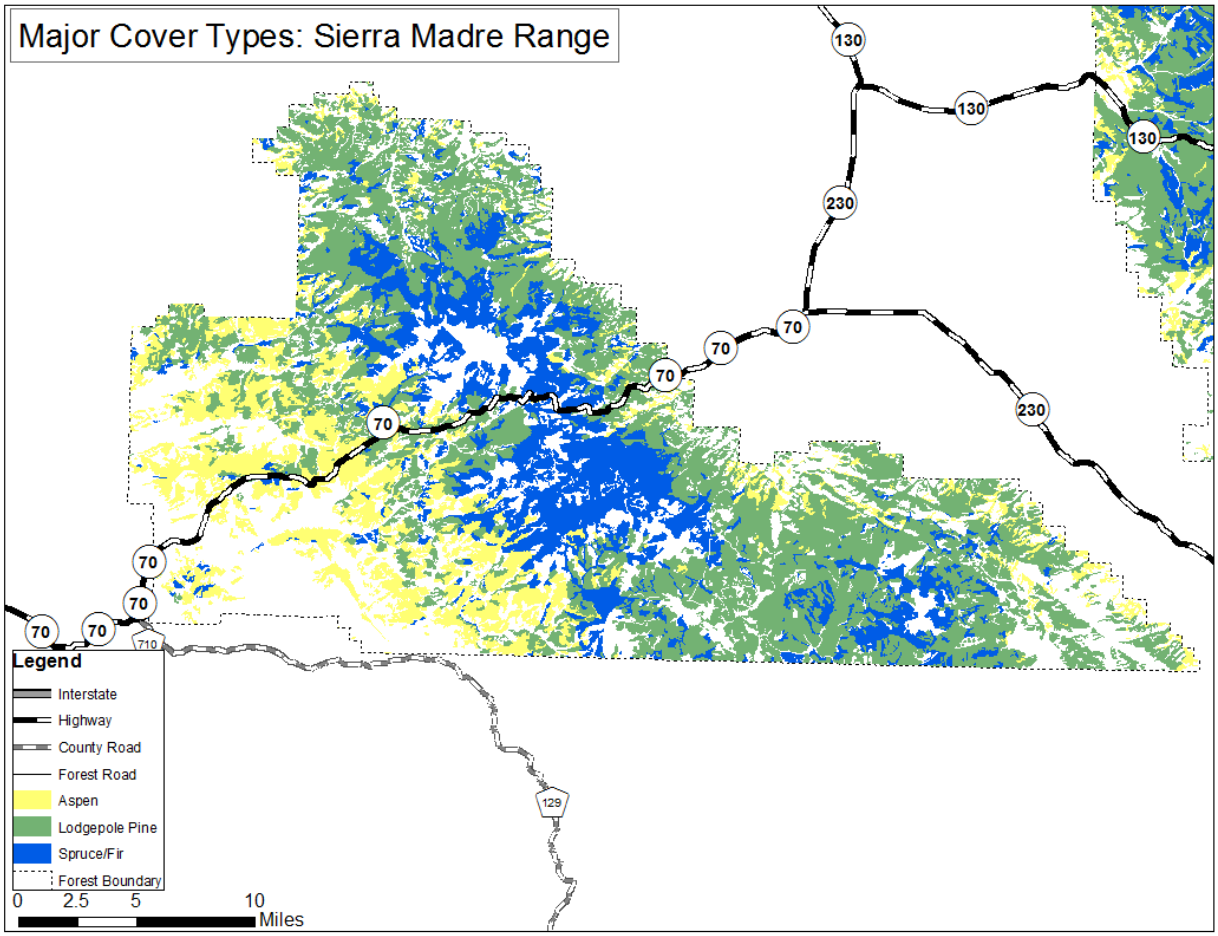
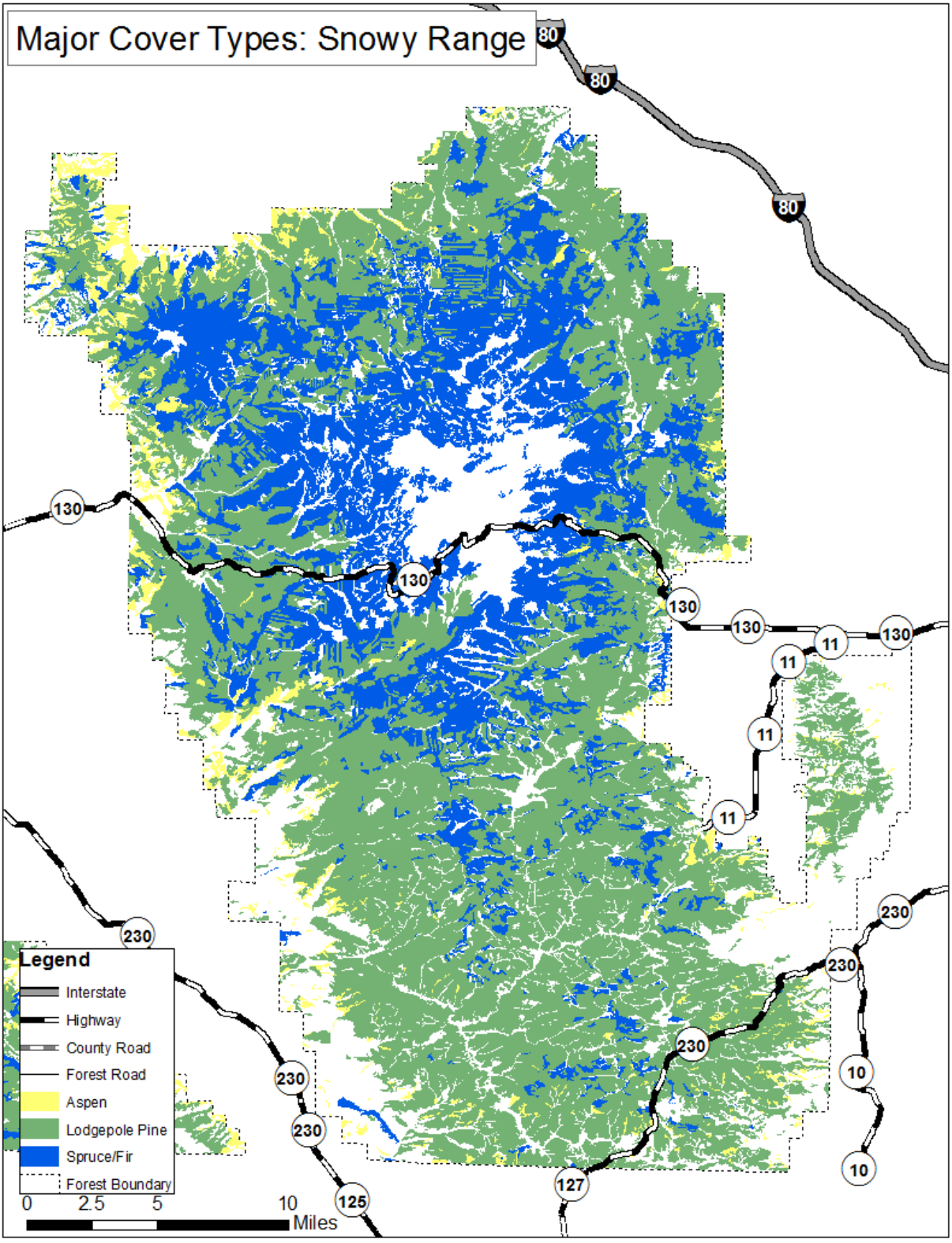


Figure 2: Major Treed Cover Types of the Snowy Range



This report focuses on the three main treed cover types represented on the Sierra Madre and Snowy Ranges: Lodgepole pine, Spruce/fir and aspen cover types. Other treed cover types in the LAVA project area include: ponderosa pine cover type 162 acres; Douglas-fir cover type 7,217 acres; limber pine cover type 1,013 acres, Cottonwood cover type 457; willow cover type 13,523 acres; and Rocky mountain juniper 33 acres. All cover types within the LAVA project boundary may be subject to vegetation management.

Lodgepole Pine Cover Type

The lodgepole pine cover type on the Sierra Madre Range primarily consists of mid successional stages. (Figure 3) This cover type ranges from pure lodgepole pine stands to lodgepole pine with aspen, subalpine fir, Engelmann spruce and Douglas-fir. 44% of the cover type is classified as open (less than 40% crown cover), 41% is classified as moderately closed (40% to 70% crown cover) 10% is classified as closed (greater than 70% crown cover) and 5% is classified as shrub-seedling previously treed.

Figure 3:Lodgepole pine Habitat Structral Stages- Sierra Madre

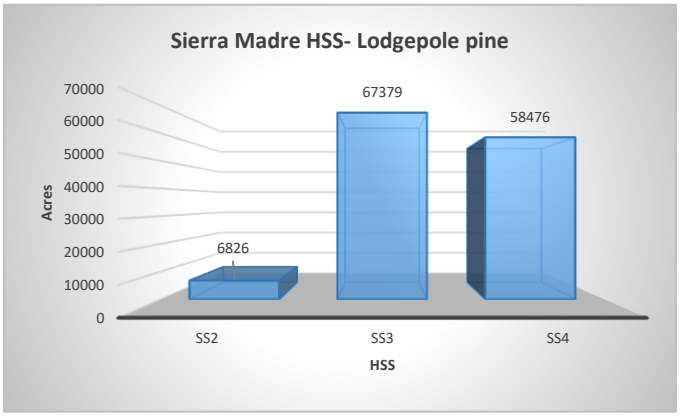


Table 3: Lodgepole pine stand structure characteristics- Sierra Madre Range

Crown Cover percent	total acres	% of area
< 40%	58643	44%
40% - 70%	53868	41%
>70%	13344	10%

Habitat Structural Stage	Total Acres	% of cover type	Acres with mortality	Percentage of structural stage with mortality
2	6826	5%	608	9%
3	67379	51%	50073	74%
4	58476	44%	42175	72%

The lodgepole pine cover type on the Snowy Range primarily consists of mid successional stages. (Figure 4) This cover type ranges from pure lodgepole pine stands to lodgepole pine with aspen, subalpine fir, Engelmann spruce and Douglas-fir. 60% of the cover type is classified as open (less than 40% crown cover), 31% is classified as moderately closed (40% to 70% crown cover) 3% is classified as closed (greater than 70% crown cover) and 6% is classified as shrub-seedling previously treed.

Figure 4: Lodgepole pine Habitat Structral Stages- Snowy Range

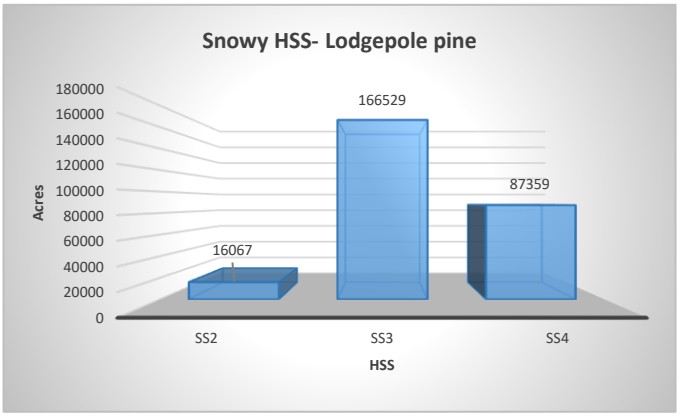


Table 4: Lodgepole pine stand structure characteristics- Snowy Range

Crown Cover percent	total acres	% of area
< 40%	163294	60%
40% - 70%	83581	31%
>70%	7013	3%

Habitat Structural Stage	Total Acres	% of cover type	Acres with mortality	Percentage of structural stage with mortality
2	16067	6%	1816	11%
3	166529	62%	98986	59%
4	87359	32%	46194	53%

Engelmann Spruce/ Subalpine Fir Cover type

The Engelmann spruce and sub alpine-fir cover type on the Sierra Madre range primarily consists of late successional stages. (Figure 5) This cover type ranges from high elevation Engelmann spruce and sub alpine fir to a mix of Engelmann spruce sub alpine fir and lodgepole pine at lower elevations around 9,000 feet. On the west side of the Sierra Madre range the spruce/fir cover type transitions to a mix of lodgepole and aspen at lower elevations. 47% of the cover type is classified as open (less than 40% crown cover), 44% is classified as moderately closed (40% to 70% crown cover) 5% is classified as closed (greater than 70% crown cover) and 5% is classified as shrub-seedling previously treed.

Figure 5: Spruce Fir Habitat Structral Stages- Sierra Madre

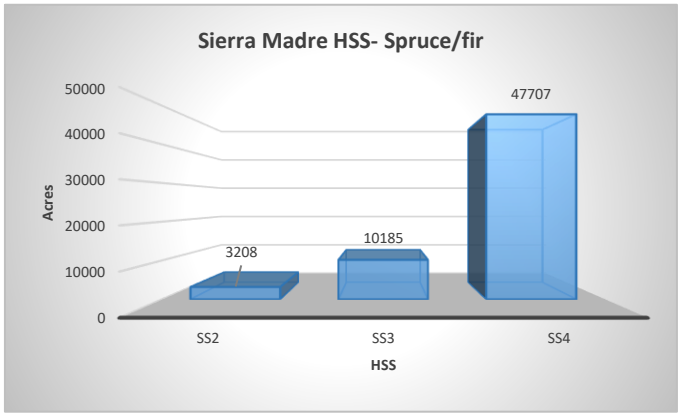


Table 5:Spruce/fir stand structure characteristics- Sierra Madre

Crown Cover percent	total acres	% of area
< 40%	28465	47%
40% - 70%	2661	41%
>70%	2816	5%

Habitat Structural Stage	Total Acres	% of cover type	Acres with mortality	Percentage of structural stage with mortality
2	3208	5%	432	13%
3	10185	17%	4466	44%
4	47707	78%	13709	29%

The Engelmann spruce and sub alpine-fir cover type on the Snowy Range primarily consists of late successional stages. (Figure 6) This cover type ranges from high elevation Engelmann spruce and sub alpine fir to a mix of Engelmann spruce sub alpine fir and lodgepole pine at lower elevations around 9,000 feet. 47% of the cover type is classified as open (less than 40% crown cover), 46% is classified as moderately closed (40% to 70% crown cover) 2% is classified as closed (greater than 70% crown cover) and 5% is classified as shrub-seedling previously treed.

Figure 6: Spruce Fir Habitat Structral Stages- Snowy Range

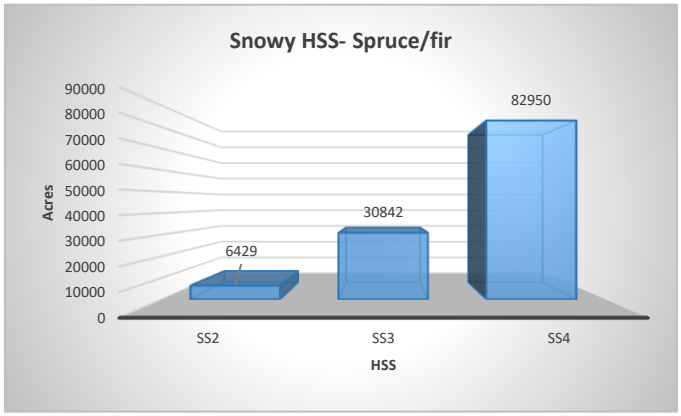


Table 6: Spruce/fir stand structure characteristics- Snowy Range

Crown Cover percent	total acres	% of area
< 40%	56094	47%
40% - 70%	54912	46%
>70%	2786	2%

Habitat Structural Stage	Total Acres	% of cover type	Acres with mortality	Percentage of structural stage with mortality
2	6429	5%	1747	27%
3	30842	26%	16893	55%
4	82950	69%	50313	61%

Aspen Cover Type

The aspen cover type on the Sierra Madre range primarily consists of mid successional stages. (Figure 7) When mixed with confer cover types aspen is found along meadows and drainages. In the western portion of the Sierra Madre range aspen becomes the dominate cover type and is found on all aspects. 46% of the cover type is classified as open (less than 40% crown cover), 50% is classified as moderately closed (40% to 70% crown cover) 1% is classified as closed (greater than 70% crown cover) and 3% is classified as shrub-seedling previously treed.

Figure 7: Aspen Habitat Structral Stages- Sierra Madre

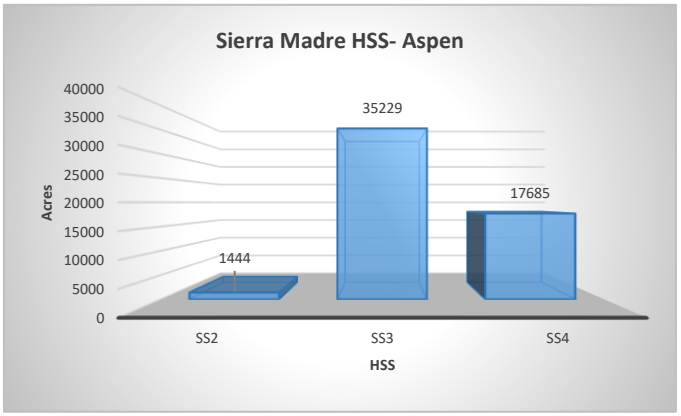


Table 7: Aspen stand structure characteristics- Sierra Madre Range

Crown Cover percent	total acres	% of area
< 40%	24793	46%
40% - 70%	27436	50%
>70%	685	1%

Habitat Structural Stage	Total Acres	% of cover type	Acres with mortality	Percentage of structural stage with mortality
2	1444	3%	558	39%
3	35229	65%	6796	19%
4	17685	33%	5214	29%

The aspen cover type on the Snowy range primarily consists of mid successional stages. (Figure 8) On the Snowy Range aspen is primarily found along drainages, wet meadows and other wet areas. This cover types is a minimal component of the tree cover types on the Snowy Range. 45% of the cover type is classified as open (less than 40% crown cover), 44% is classified as moderately closed (40% to 70% crown cover) 9% is classified as closed (greater than 70% crown cover) and 3% is classified as shrub-seedling previously treed.

Figure 8: Aspen Habitat Structral Stages- Snowy Range

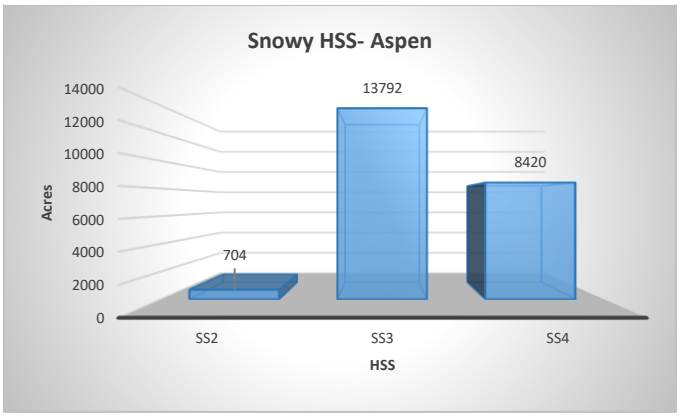


Table 8: Aspen stand structure characteristics- Snowy Range

Crown Cover percent	total acres	% of area
< 40%	10245	45%
40% - 70%	10015	44%
>70%	1952	9%

Habitat Structural Stage	Total Acres	% of cover type	Acres with mortality	Percentage of structural stage with mortality
2	704	3%	306	433%
3	13792	60	6130	44%
4	8420	37%	3590	43%

Table 9: Cover Type and Habitat Structural Stage by Analysis Unit- acres and percentage

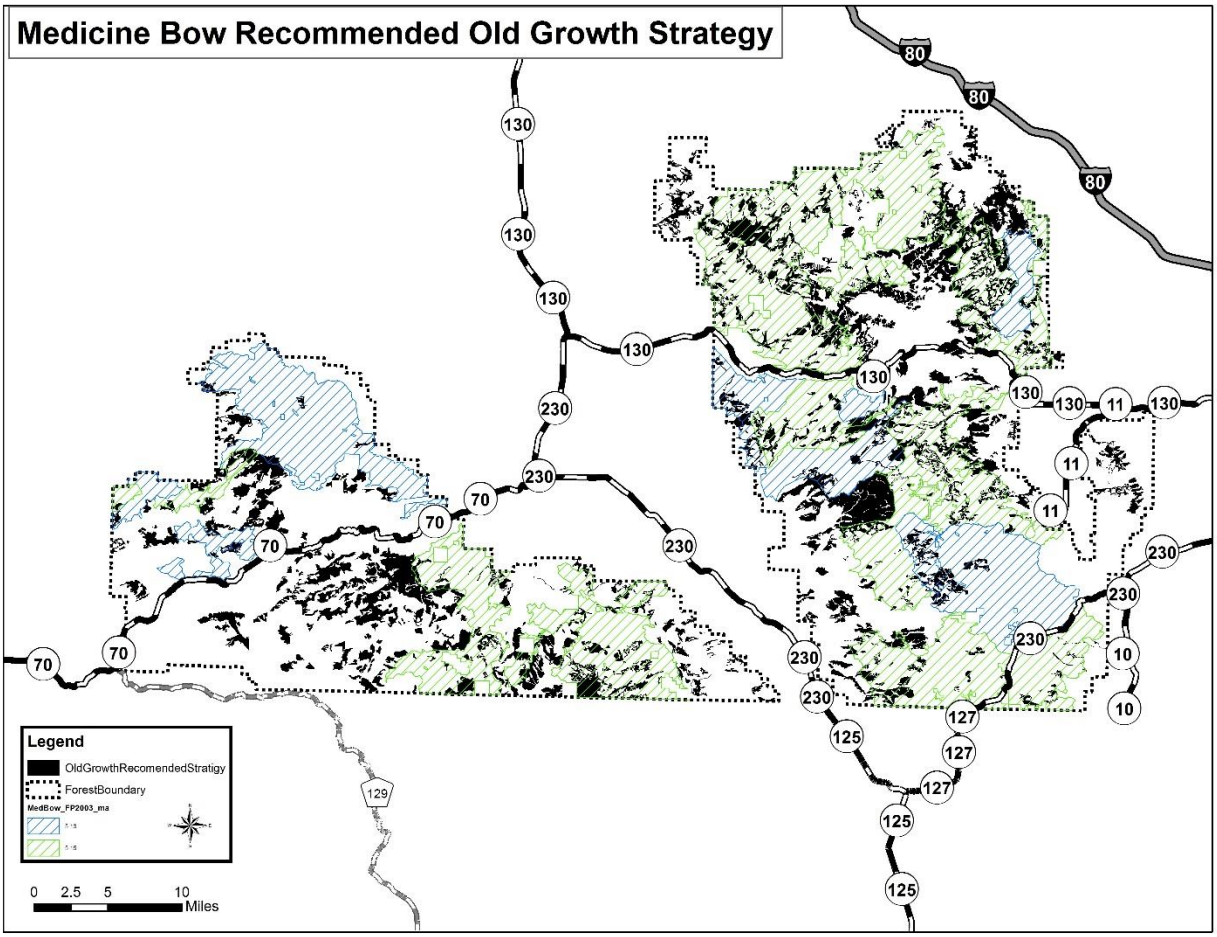
		Cover type			Structural Stage			
Analysis Unit	**Acres in AU**	**LP**	**SF**	**AS**	**SS1**	**SS2**	**SS3**	**SS4**
BattlePass	**30833**	10100	9449	2353	8536	1016	7640	13399
BigBlackhall	**48316**	25172	4630	2571	15178	4838	19335	8954
BowKettle	**45497**	21688	15675	2803	3238	4906	23336	13966
CedarBrush	**46984**	19139	16228	2629	7478	2965	17955	18422
FoxWood	**80270**	54977	2916	1723	16392	7193	43457	12967
FrenchDouglas	**47360**	29781	10111	679	3499	6208	19208	18329
GreenHog	**36714**	15027	6847	5598	8954	1220	12689	13838
JackSavery	**74195**	34086	14610	5979	18826	3050	23886	28016
NorthCorner	**31493**	13711	10197	872	5767	2056	13691	9775
OwenSheep	**24011**	9406	164	572	13653	151	4163	5940
PeltonPlatte	**21689**	13245	631	828	5358	2459	10070	3802
RockMorgan	**38030**	22722	10283	409	3931	4139	15203	14646
SandyBattle	**74168**	12481	1750	25554	28139	7396	20674	17709
WestFrench	**54214**	26606	16125	2449	7605	4049	22411	20066
Total	**653775**	**308141**	**119616**	**55019**	146554	51647	253718	199829

		Cover type			Structural Stage			
Analysis Unit	**Acres in AU**	**LP**	**SF**	**AS**	**SS1**	**SS2**	**SS3**	**SS4**
BattlePass	**30833**	32.8%	30.6%	7.6%	27.7%	3.3%	24.8%	43.5%
BigBlackhall	**48316**	52.1%	9.6%	5.3%	31.4%	10.0%	40.0%	18.5%
BowKettle	**45497**	47.7%	34.5%	6.2%	7.1%	10.8%	51.3%	30.7%
CedarBrush	**46984**	40.7%	34.5%	5.6%	15.9%	6.3%	38.2%	39.2%
FoxWood	**80270**	68.5%	3.6%	2.1%	20.4%	9.0%	54.1%	16.2%
FrenchDouglas	**47360**	62.9%	21.3%	1.4%	7.4%	13.1%	40.6%	38.7%
GreenHog	**36714**	40.9%	18.6%	15.2%	24.4%	3.3%	34.6%	37.7%
JackSavery	**74195**	45.9%	19.7%	8.1%	25.4%	4.1%	32.2%	37.8%
NorthCorner	**31493**	43.5%	32.4%	2.8%	18.3%	6.5%	43.5%	31.0%
OwenSheep	**24011**	39.2%	0.7%	2.4%	56.9%	0.6%	17.3%	24.7%
PeltonPlatte	**21689**	61.1%	2.9%	3.8%	24.7%	11.3%	46.4%	17.5%
RockMorgan	**38030**	59.7%	27.0%	1.1%	10.3%	10.9%	40.0%	38.5%
SandyBattle	**74168**	16.8%	2.4%	34.5%	37.9%	10.0%	27.9%	23.9%
WestFrench	**54214**	49.1%	29.7%	4.5%	14.0%	7.5%	41.3%	37.0%
Total	**653775**							

Table 9 shows the acres of each of the main cover types (LP- lodgepole pine; SF- Engelmann spruce and subalpine fir; AS- aspen) by accounting unit, the structural stage make up and the percentages of cover type and structural stage by analysis unit. The figures in the tables only include acres that are within the treatment opportunity area and are considered a treed cover type. Lodgepole pine is the main cover type and more acres are in structural stage three followed by stage four.

Old Growth

Figure 9: Old Growth Locations within the Project Area



The map above shows the location of the old growth recommended strategy (Black) along with management areas 5.13 (Blue) and 5.15 (Green).

145,330 acres of old growth have been identify within the project area. Mapped stands most likely have been affected by mountain pine and spruce beetle activity. These stands will remain as mapped old growth to meet Forest Plan standards and guidelines. Stands affected by insects are expected to lose canopy closure but will retain other characteristics of old-growth stands. For the Landscape Vegetation Analysis mapped old growth within management area 5.15 (Forest Products, Ecological Maintenance

and Restoration) were removed from treatment areas and will not have vegetation management preformed within them as part of this project. 41,516 acres of old growth are within the treatment opportunity area for the project. These identified old growth stands are outside of management area 5.15 and vegetation management can be conducted within these stands as long as treatments maintain or promote characteristics of old growth stands, new stands are identified that meet the requirements of old growth and are incorporated into the Forests old growth strategy.

Disturbance History

Disturbances are a part of ecosystem processes that forests have adapted to. Short-term changes are dramatic and substantial, but forests will regenerate and thrive again. In the central Rocky Mountain ecosystem, disturbance is the critical factor in maintaining co-existing species. Without disturbance, climax species such as subalpine fir and Engelmann spruce would replace disturbance dependent species such as lodgepole pine and aspen. Three of the more common disturbances are insects and disease, fire and vegetation management.

Insects and Disease

According to Forest Health and Protection which conducts annual areal forest insect and disease surveys there is current spruce beetle, mountain pine beetle, western balsam bark beetle, western spruce bud worm, and an unknown defoliator. (FHP 2016 flight data)

Figure 10: Mountian Pine Beetle and Spruce Beetle Damage 2000-2016

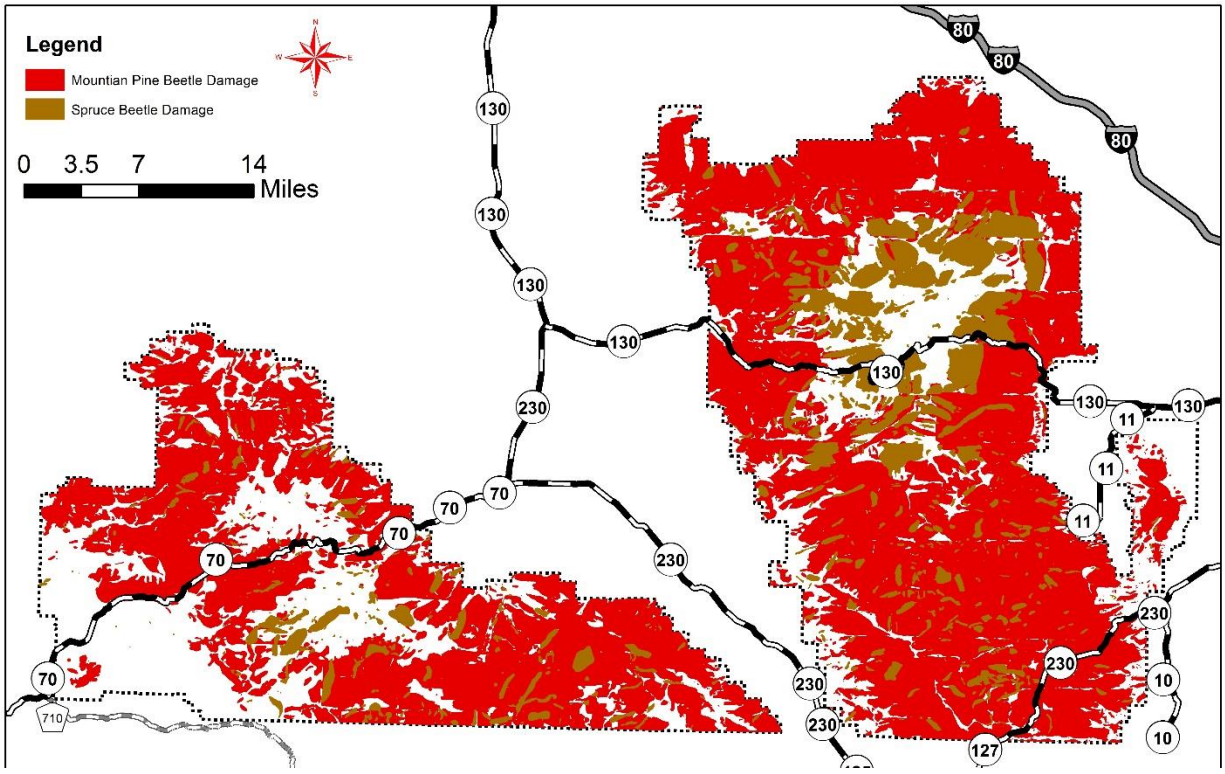
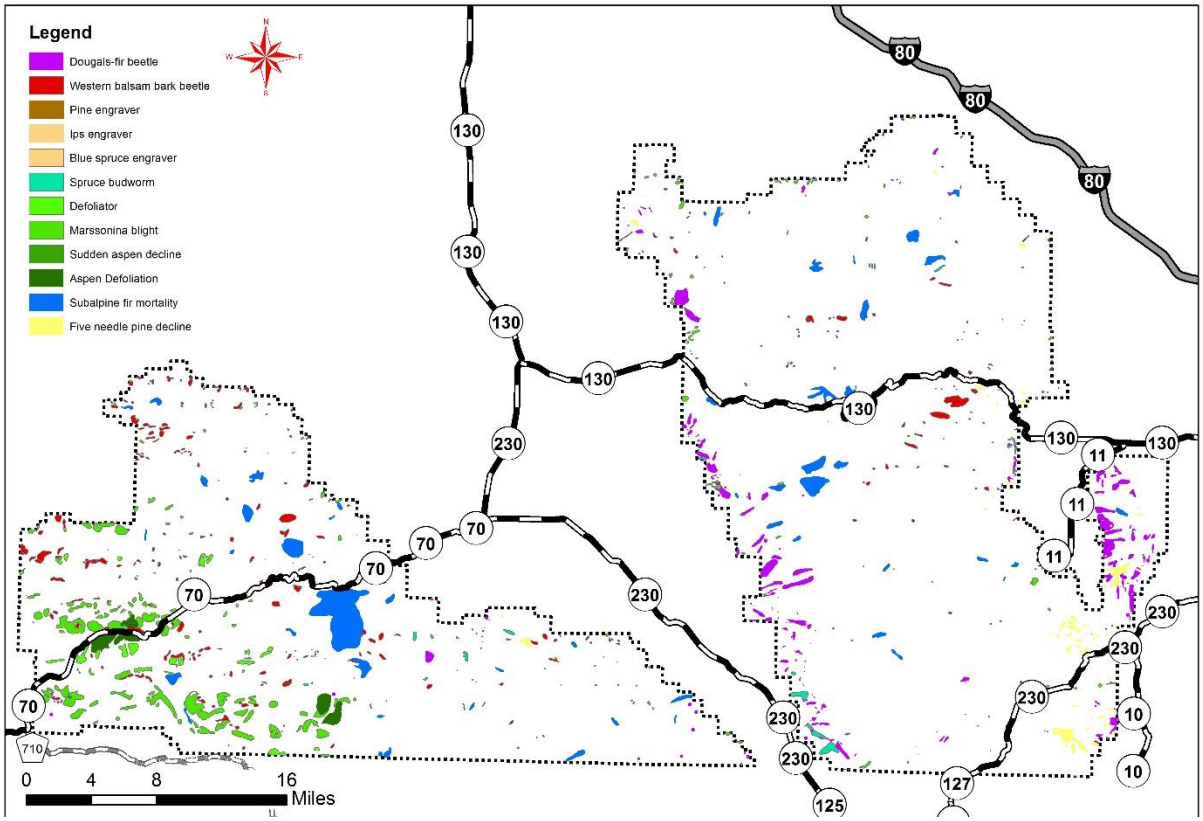


Figure 11: Insect and Disease Damage 2000-2016



Mountain Pine Beetle (Dendroctonus ponderosae)

Mountain Pine Beetle is a bark beetle that is naturally occurring in ecosystems at endemic levels. This beetle occurs in most pines including ponderosa, limber and lodgepole pine. Within the AA MPB has caused approximately 605,034 acres of damage. When attacking conifer trees the beetles introduce a blue stain fungus into the tree's living tissues interrupting the transport of water and nutrients, which eventually kills the tree. The tree's only defense against beetles is its sap, or resin, which the trees use to "pitch out," attacking beetles. (Gibson 2009) Trees that are stressed due to drought, fire, external damage or other forest pests are more readily and successfully attacked by MPB. However younger healthier trees that are not stressed can produce more sap thus more effectively protect themselves.

Table 10: Insect and Disease Damage 2000-2016

Cause	Acres
mountain pine beetle	605,034
spruce beetle	101,693
Douglas-fir beetle	9,757
western balsam bark beetle	7,146
engraver beetles	20
spruce budworm	1,230
aspen insects and diseases	16,415
sub alpine fir mortality	14,327
five needle pine decline	3,130

Endemic levels of MPB are a natural part of the ecosystem and are naturally regulated through cold winter temperatures and through predation by birds; such as woodpeckers, small mammals, and other insects. Most likely epidemic levels of mountain pine beetle are associated with drought conditions and periods of above average winter temperatures (Bentz 1991). Dense mature stands have little or no defense against epidemic levels of beetles in which even healthy trees are subject to infestation and an entire stand can be killed.

The United States Forest Service's, Forest Health Protection (FHP) group tracks through aerial surveys and researches forest pests. 2016 aerial survey showed that mountain pine beetle activity is low with about 600 acres of limber pine within Carbon and Albany counties showing signs of infestation and no new activity in lodgepole pine or ponderosa pine. (Aerial Detection 2016)

Spruce Beetle (Dendroctonus rufipennis)

Spruce beetle, also a bark beetle, occurs within the natural range of their principle host species, Engelmann spruce. Within the AA spruce beetle has infested around 101,693 acres. As with MPB, spruce beetle attacks the tree and introduces a blue stain fungus into the tree. The only defense of the tree is to pitch out the insect. Epidemic levels of spruce beetle populations often coincide with large blowdown events and drought conditions. As native insects, endemic populations of spruce beetle have an important role in removing over-mature, diseased, and stressed trees from forest ecosystems. They are a food source for many wildlife species and dead trees created by the bark beetles benefit numerous wildlife species (Schmid 1977).

2016 aerial surveys performed by the Forest Service Forest Health Protection group observed 240 acres of spruce beetle activity in Carbon and Albany counties. (Aerial Detection 2016)

Subalpine Fir Decline

Subalpine fir mortality from a variety of agents is often detected at low levels across large areas. Overtime the low levels of mortality can accumulate into significant levels of overstory mortality. Currently 21,473 acres of subalpine fir within the analysis area have/are experiencing mortality. 2016 FHP aerial surveys detected 25,000 acres of varying levels of mortality across Wyoming. (Aerial Detection 2016)

Aspen Insects and Diseases

Sudden Aspen Decline (SAD) was first noticed in the region during 2004. Stands with in the AA have been observed with signs of this decline. SAD is characterized by sudden branch died back resulting in loss of crown and eventual mortality of the tree without the involvement of primary pathogens or insects. Affected stand may fail to regenerate. (Worrall 2010) It is thought the recent occurrence of SAD is the result of an "extremely warm drought" with contributing factors of elevation and aspect, and insects and disease. There is some evidence that past management, resulting in the diversification of age classes, has increased the resilience of some aspen forests to SAD. However, management activities that stimulate regeneration may result in the successful establishment of seedlings before root systems are too weak to respond. (USDA 2009) Other damaging agents to aspen including Marssonina leaf blight and unknown defoliation are occurring within the project area. According to 2000-2016 FHP aerial insect and disease damage survey 16,415 acres of aspen cover type within the project area have been affected by SAD/defoliation.

Dwarf Mistletoe

Dwarf mistletoes are parasitic plants that grow on pines and other conifers, slowing and distorting growth and leading to early death. Infection by these plants is the most common and economically damaging forest disease in most of the western states (USDA 2009). Within the project area lodgepole pine and ponderosa pine are most affected and mistletoe infestations have been observed throughout the area. It is generally agreed that a century or more of fire suppression and exclusion has resulted in an increase in the abundance of dwarf mistletoe in many parts of the west (USDA 2009). Witches

brooms and increased litter fall can be caused by mistletoe. This can lead to an increase in vertical fuel continuity causing surface fires to transition to stand replacing crown fires (Kipflmueller 1997). Dwarf mistletoes can be managed through different silvicultural practices; the most effective being even-aged management and the least effective uneven-aged management.

Fire

Wildfire has played a large part in the stand structure of all forested vegetation types across the project areas. The fire and fuels report contains the relevant information regarding fire history of the project area.

Vegetation Management

For the purposes of this analysis vegetation management will be described as alteration of woody vegetation for purposes of timber harvest, fuels reduction and hazard tree removal. Vegetation management has occurred within the project area since the late 1800's through present day. (Dillon 2005)

Selective harvesting of lodgepole pine for the creation of railroad ties started in the mid 1800's. Trees 10-14 inches diameter at breast height were cut for railroad ties and telegraph poles. (Dillon 2005) Extensive harvesting of timber started in the 1960s using mostly clear cutting with a few other silvicultural systems such as shelterwood harvests; group selection; overstory removal; and single tree selection.

Table 11: Past Treatments in the Analysis Area Since 1960. FACTS Database

Laramie Ranger District			**Brush Creek Hayden Ranger District**	
Treatment	Acres		Treatment	Acres
Commercial Thin	1019		Commercial Thin	3962
Group Selection Cut (UA/RH/FH)	388		Group Selection Cut (UA/RH/FH)	766
Overstory Removal Cut (from advanced regeneration) (EA/RH/FH)	4187		Improvement Cut	2
Patch Clearcut (EA/RH/FH)	418		Overstory Removal Cut (from advanced regeneration) (EA/RH/FH)	7236.6
Salvage Cut (intermediate treatment, not regeneration)	2306.1		Patch Clearcut (EA/RH/FH)	3345
Sanitation Cut	1155		Salvage Cut (intermediate treatment, not regeneration)	1299
Seed-tree Removal Cut (w/ leave trees) (EA/NRH/FH)	51		Sanitation Cut	6750
Shelterwood Establishment Cut (with or without leave trees) (EA/RH/NFH)	229		Shelterwood Establishment Cut (with or without leave trees) (EA/RH/NFH)	1281
Shelterwood Preparatory Cut (EA/NRH/NFH)	4407		Shelterwood Preparatory Cut (EA/NRH/NFH)	15255
Single-tree Selection Cut (UA/RH/FH)	1716		Shelterwood Removal Cut (EA/NRH/FH)	659
Stand Clearcut (EA/RH/FH)	20997		Shelterwood Removal Cut (w/ leave trees) (EA/NRH/FH)	235
Laramie RD Total	**36,873.1**		Single-tree Selection Cut (UA/RH/FH)	1148
			Stand Clearcut (EA/RH/FH)	34473
			Two-aged Shelterwood Establishment Cut (w/res) (2A/RH/NFH)	75
			Brush Creek Hayden Total	**76,486.6**

Table 11 shows that 113,359 acres of harvesting activities occurred within the analysis area since 1960 (36,873 on the Laramie Range District and 76,486 acres on the Brush creek Hayden Ranger District) according to the Forest Service FACTS database. Approximately half (55,470 acres) of the acres harvested used a clearcut silvicultural system. Aerial photography shows the patchwork of vegetation treatments that has occurred within the AA. The photography also shows that harvesting has area of concentration, mainly in Forest Management areas 5.13 Forest Products, and 5.15 Forest Products, Ecological Maintenance and Restoration. Rectangular shaped cutting units of past treatments to irregular shaped units of more recent treatments are spread across the landscape with concentrations found in areas designated for timber management. There are multiple current or shortly anticipated vegetation management projects expected within the project area.

Table 12: Current and Expected Vegetation Management by Mountain Range

Sierra Madre Range	Snowy Range
Box Canyon Reoffer 2 Timber Sale	Badger Creek Timber Sale
Capitol Timber Sale	Foxborough Timber Sale
Cerberus Timber Sale	HWY 130/CPL&L Settlement Sale
Chum Timber Sale	Lake Owen Timber Sale
Citadel Timber Sale	Porter Creek Timber Sale
Hell Canyon Timber Sale	Race Horse Reoffer Timber sale
McAnulty Reoffer 3 Timber Sale	Spruce East Timber Sale
Spinner Timber Sale	Cedar 261 Stewardship- Hazard tree clearing
Patriot Stewardship	Brooklyn Nash Stewardship- Hazard tree clearing
Skyline 415 Stewardship- Hazard tree clearing	Caixa Stewardship- Hazard tree clearing
Zarb Stewardship- Hazard tree clearing	NFSR 542 Beaver Stewardship- Hazard tree clearing
Divide Peak Prescribed Burn	Bald Mountain Prescribed Burn
Sandstone Prescribed Burn	Mill Creek Prescribed Burn
Battle Mountain Prescribed Burn	Fox Creek CE
Ryan Park CE	

Desired Conditions

Instead of identifying a single desired condition for each cover type a range of preferred conditions will be discussed.

Table 13: Forest Plan 50 Year Habitat Structral Stage Desired Condtions

Cover Type	SS1	SS2	SS3	SS4	SS5
Lodgepole	2%	16%	36%	23%	23%
Spruce/fir	4%	15%	21%	28%	34%
Ponderosa	6%	8%	16%	45%	28%
Aspen	3%	12%	26%	17%	41%

Lodgepole pine cover type

Stands of healthy lodgepole pine of various structural stages, moving toward Forest Plan identified desired conditions, will be present across the landscape. Managed stands will have less dead overstory, dead and down material and a decreased presence of other insects and diseases then unmanaged stands. Increased growth of saplings and active sprouting of seedlings will occur. Outside of timber management areas stocking densities and species composition will vary from pure lodgepole pine to almost a mixed conifer condition. Within management areas 5.13 and 5.15 lodgepole pine will have a more managed appearance with a very low presence of insects and diseases. Species composition in these management areas will favor lodgepole pine. Stocking densities will be at suitable levels to promote growth and reduce the likelihood of future MPB epidemics. Across the landscape more young (habitat structural stage 2) stands will be present moving conditions toward the identified Forest Plan 50 year desired stand conditions.

Spruce/Fir cover type

Stands of healthy Engelmann spruce and sub alpine fir of various structural stages, moving toward Forest Plan identified desired conditions, will be present across the landscape. Managed stands will have less dead overstory, dead and down material and a decreased presence of other insects and diseases then unmanaged stands. High densities of Engelmann spruce and sub alpine fir seedlings will persist in the understory creating uneven-aged stand conditions or as regenerating stands in areas managed for group selection cuts. Species composition will vary from spruce/fir stands to spruce/fir mixed with some lodgepole pine. Within management areas 5.13 and 5.15 management of the spruce/fir cover type will be more prevalent. Management of this cover type using approved silvicultural systems (as designated in the Forest Plan) will appear more often. Stocking densities will be at suitable levels to promote growth and reduce the likelihood of future Spruce beetle epidemics. Across the landscape more young (habitat structural stage 2) stands will be present moving conditions toward the identified Forest Plan 50 year desired stand conditions.

Aspen cover type

Generally, the desired condition for aspen is to consist of predominantly pure aspen with some stands mixing with conifers. A mosaic of understory grass/forbs, brush, and active sprouting/suckering of aspen will be found in conjunction with varying conditions of aspen overstory. A mosaic of stand structure/age classes will exist within stands and across the landscape. Older, decadent along with intermediate and young aged aspen are distributed across the landscape. More young (habitat structural stage 2) stands will be present moving conditions toward the identified Forest Plan 50 year desired stand conditions. Browsing of aspen regeneration by native and non-native ungulates will be present but spread-out across the landscape so that browsing effects to regeneration will be minimized.

ENVIRONMENTAL CONSEQUENCES

Alternative 1 – No Action

In most environmental analyses the no action alternative represents a static, relatively unchanging baseline of the AA's existing condition that can be used to compare the potential effects of the action alternatives. However within the analysis area due to the MPB and spruce beetle epidemics the no action alternative would have major implications to the timber resource in the area. Under the No Action Alternative, current management plans would continue to guide management of the project area. No silvicultural treatments to remove dead trees, to reduce current and future fuel hazards, protect infrastructure, enhance wildlife habitat and improve forest health conditions and resiliency would be implemented.

Lodgepole Pine Cover type

Direct and Indirect Effects

Current stand conditions will persist in the short term. Areas with the majority of the overstory dead are anticipated to succumb to windthrow resulting in high levels of dead and down trees on the ground (Figure 12b). Due to the increased sun exposure increases in grass and forb production and where adequate seed is present germination of lodgepole pine seedlings is expected (Figure 12a). On dead trees the viability of seeds found within serotinous cones decrease with age. Seeds contained in 15 year old closed cones show a steep decline in viability. (Teste 2011) If a disturbance does not occur before seed viability is low regeneration potential will most likely be reduced. With many trees with in the project area approaching 15 years after mortality regeneration of lodgepole pine could become problematic. Current live sapling and pole sized trees that do not succumb to windthrow will continue to grow and develop into the dominant canopy layer.

Areas with canopy mortality less than 30-50% will result in partially shaded conditions which would favor the establishment of more shade tolerant species such as subalpine fir (Collins 2010). Subalpine fir currently in the understory will continue to grow in these favorable light conditions. In the long-term these stands would persist as a lodgepole pine cover type, the percentage of subalpine fir in the understory would be higher due to the gradual deterioration of canopy cover (Figure 12c). Over time subalpine fir will move into a dominant canopy position further suppressing regeneration of shade intolerant species. Generally stands that experience low mortality were composed of smaller diameter trees. Without management

Figure 12: No action Lodgepole Pine conditions

(a) Greater than 50% mortality with lodgepole pine regeneration occurring.

(b) Windthrow of dead lodgepole pine.

(c) Subalpine fir regenerating under lodgepole pine in partially shaded conditions.

(d) Stagnated stand of Lodgepole pine

most of these stands will reach the maximum tree carrying capacity and growth will stagnate (Figure 12d). These types of stand structure could limit future availability of commercial products and limit management options. Previously managed and non-managed stands with low mortality will continue to grow and provide for future commercial products and a wide array of management options.

Figure 12 Continued

(e) Previously managed stand with low mortality

Engelmann Spruce/ Subalpine Fir Cover type

Direct and Indirect Effects

Dead spruce and fir will most likely succumb to windthrow as dead trees experience rot and mechanical stress from wind. Live trees will also blowdown due to higher levels of wind exposure as a result of the loss of canopy cover (Figure 13a). Stands with multi stratum canopies will see intermediate canopies grow into the overstory.

Stands with greater abundance of subalpine fir in the understory will result in a decrease in the presence of Engelmann spruce within the stand in the short term (Figure 13c). Seed sources for establishment of new spruce seedlings will most likely be reduced until the remaining spruce trees in the understory grow through the subalpine fir canopy and become mature co-dominant trees (Veblen 1991).

Forest floor conditions will remain relatively stable with little mineral soil being exposed resulting in conditions more favorable for subalpine fir germination (USDA 1990). Subalpine fir can also reproduce by layering which can lead to an increase presence of subalpine fir in the understory. Exposed mineral soil from windthrown trees will create pockets that are more suitable for seed germination for Engelmann spruce and subalpine fir.

In the long term Engelmann spruce will regain the dominant position in the spruce fir stands until the next disturbance agent occurs (Alexander 1987)

Figure 13: No Action Spruce/Fir Cover Type Conditions

13(a) Overstory Engelmann spruce and subalpine fir mortality

13(b) Single storied spruce-fir stand

13(c) Multistoried spruce-fir stand with predominantly subalpine fir understory

Aspen Cover type

Direct and Indirect Effects

Aspen stands along the edge of mature conifer stands that experienced significant mortality could expand due to more light reaching the forest floor. Individual tree growth could increase as the availability of light and nutrients increases. However other factors affecting aspen health across the landscape; conifer and shrub encroachment into aspen stands and concentrated animal browsing; would not be managed.

Conifer encroachment in to aspen stands will continue inhibiting aspen regeneration by shading of young suckers (Shepperd 2001) (Figure 14a). Seral stands will persist with varying levels of insect and disease activities. Areas of high insect and disease which cause a gradual deterioration of stands can lead to regeneration failure and potential the loss of aspen clones (Debyle 1985) (Figure 14b). In the absence of disturbance that cause regeneration succession favors dominance by conifers when aspen reach 80-150 years of age (Rogers 2002).

Wildfire could result in both positive and negative effect to aspen stands. Moderate to low intensity fires that burn through aspen stands could bring multiple benefits to the stands. Encroaching conifers and shrubs could be killed, areas of heavy fuels removed and a small to moderate amount of mortality of aspen will most likely result in an increase in aspen regeneration. If a high intensity fire burned through aspen stands the fire could burn hot enough to completely kill the clone and the roots which could result in the death of the clone.

In areas where reproduction is occurring browsing of aspen by native and non-native ungulates could be concentrated resulting in the mortality of aspen regeneration (Figure 14c). The lack of surviving aspen regeneration along with the ongoing and potential mortality of overstory aspen trees could result in a loss of aspen on the landscape.

Figure 14: No Action Aspen Cover Type Conditions

14(a) conifer encroachment in aspen

14(b) Decadent stand with low levels of regeneration

14(c) Aspen damaged by browsing/trampling.

14(d) Multistoried stand with mortality and active regeneration.

Cumulative Effects: No Action

In the lodgepole pine cover type, MPB caused mortality has resulted in a loss of the majority of the overstory. This loss has set many lodgepole stands back to early successional or early mid successional status. Without treatment regeneration of lodgepole pine will be at a slower rate and non-commercially viable species such as subalpine fir could increase in presence and reduce the presence of lodgepole pine across the cover type. Spruce beetle and western balsam bark beetle caused mortality to overstory and midstory Engelmann spruce and subalpine fir. Loss of these canopy layers reduces options for how a stand may be managed in the future. In the short term these

stands will become dominated by subalpine fir, which persists for long periods and is a less desirable commercial species. Rotation ages may need to be lengthened because of the relatively slow growth of fir, compared to spruce (Alexander 1987). The loss of conifer overstory and midstory will result in a loss of timber production and a longer time frame for the stands to be put back into commercial production.

Without management the spread of dwarf mistletoe will go unchecked. Vegetation management to remove infected overstory lodgepole pine will not be conducted. This results in conditions where seedling and sapling sized lodgepole pine could become infected with mistletoe. The parasitic plant would slow the growth of and could cause mortality to lodgepole (Kipfmueller 1997). This could result in a buildup of forest fuels and increase the risk of a forest fire. Also mistletoe could slow individual tree and stand growth causing a longer time frame for infected stands to produce commercial products.

Increased dead fuel loads increases the fire hazard and the potential for catastrophic fire. High intensity fires have the potential to destroy the remaining live overstory and the seed source contained in the cones and duff layer. This would result in little to no regeneration occurring post fire (USDA 1990). Within the lodgepole pine cover type increased percentages of subalpine fir results in more ladder fuels increasing the risk for stand replacing crown fire. Low intensity fires which leave the seed source in the canopy and do not consume the entire duff layer could result in regeneration occurring more rapidly and at high densities. Within the Engelmann spruce/subalpine fir cover type severe fires in areas of heavy dead and down fuels could cause a transition to a subalpine grassland or aspen type resulting in a slow recovery; decades; to a spruce-fir climax community (Alexander 1987).

Within the aspen cover type areas experiencing mortality from insect and diseases will continue to deteriorate. This could result in a decline in the presence of aspen across the landscape. Grazing in stressed aspen clones that are experiencing defoliation could result in the complete loss of sapling and seedling sized trees and the eventual death to the aspen clone. Vegetation treatments under other NEPA decisions in and adjacent to the aspen stands could result in a localized increase in aspen abundance if enough disturbance occurs within aspen stands.

Past vegetation management activities created varying stand structure and patch size across the landscape. Young and mid-aged stands where density of trees was managed experienced less mortality due to bark beetles then non managed stands (Figure 12e). The variation of stand structure, patch size and density created areas of resilience on a small scale but have not affected the resilience of the forest at a landscape scale.

Healthy stands provide several management options into the future, but dead stands offer fewer options. Virtually all of the suitable timber sites are important for their near or long-term contribution to the goals for production of commercially valuable wood products. If the current conditions of designated suitable timber harvest stands persist and no treatments occur, then the acres effected by bark beetles and other insects and disease will no longer meet objectives set out in the Forest Plan.

Alternative 2 – Proposed Action

Three treatment categories are proposed in the Proposed Action alternative. Table 14 depicts the three treatment categories the silvicultural treatment option and objectives, concerns and associated treatments.

Up to 95,000 acres of treatments that would cause a stand to revert to the stand initiation structural stage. This stage immediately follows the stand-replacing disturbance. Regeneration of open space from seed, sprouts and advanced regeneration occurs or planting may be conducted as necessary. Generally treatments result in one age class of trees. The stage ends when tree canopy becomes continuous and trees begin to compete with each other for light and canopy space.

Up to 160,000 acres of shelterwood, intermediate or uneven-aged treatments. Shelterwood treatments in this category include preparatory and establishment cuts which do not revert a stand into a stand initiation structural stage as enough trees remain post treatment. Intermediate treatments occur after establishment of regeneration and prior to the final harvest of the stand. These treatments are designed to enhance stand composition, structure growth, health, quality, and other desired benefits. Intermediate treatments are not designed to establish regeneration. Uneven-aged treatments promote stand structure in which there are more than two age classes. Age classes of trees can be distributed throughout the stand or in small even-aged groups. The distribution of trees under uneven-aged treatments often follows an inverse j structure where there are exponentially more smaller diameter trees than medium and large diameter trees.

Up to 100,000 acres of green tree, shrub and grassland treatments. Green tree treatment types are the same as described above however the current levels of mortality, insect and diseases are low therefore the treatments fall into the green tree category. Conifer removal from aspen, shrub land and meadows are designed to remove conifer encroachment and to enhance the characteristics of these areas. Shrub land and grassland treatments are designed to decrease wildland fuels within wildland interface areas and increase quality wildlife habitat in other areas.

Table 14 below is a matrix of the LAVA project treatment types (stand initiation; shelterwood, intermediate or uneven-aged; green tree, shrub and grassland treatments), silvicultural system for each treatment type, mortality, insect and disease levels where each treatment could be applied, and other associated silvicultural concerns. The type of treatment that a stand can receive is based upon Forest Plan direction for the appropriate silviculture system by cover type (page 6), level of current mortality and/or level of insect and disease, and culmination of mean annual increment. For example a lodgepole pine stand with 50% mortality and low levels of insect and disease would meet the requirements of a stand initiation treatment. A lodgepole pine stand with 40% mortality and low levels of insect and disease would meet the requirements for an intermediate/shelterwood/uneven-aged treatment type but not a stand initiation treatment. A lodgepole pine stand without mortality or insect and diseases that has reached culmination of mean annual increment would meet the requirements for a stand initiation treatment.

Table 14: Proposed Action Treatment Options

Adaptive Mgmt. Treatment Option	Tree Cover Type Application	Regeneration Objective	% Overstory Removal	Current Mortality	CMAI	Current Insect and Disease level	Site Prep	Slash treatment	Regen Survey and Certification	Windthrow Concern	TSI Need
Stand Initiation											
Clearcut	Lodgepole, Ponderosa, Mixed Conifer	Yes (even-aged)	Up to 100%	50-100%	Yes	Moderate -High	Yes	Varies	Yes	No	Varies
Coppice	Aspen	Yes (even-aged)	Up to 100%	50-100%	n/a	Moderate -High	Yes	Varies	Yes	No	No
Stand Replacing Prescribed Fire	Lodgepole, Ponderosa, Mixed Conifer, Aspen	Yes (even-aged)	Up to 100%	50-100%	n/a	Moderate -High	Yes	Varies	Yes	No	No
Final shelterwood Removal	All	Yes (even-aged)	Up to 100%	50-100%	n/a	Moderate -High	Yes	Varies	Yes	No	No
Seed tree cut (prep)	Lodgepole, Ponderosa, Mixed conifer	Yes (even-aged)	Up to 100%	50-100%	n/a	Moderate -High	Yes	Varies	Yes	No	Varies
Overstory removal	All	Yes (even-aged)	Up to 100%	50-100%	n/a	Moderate -High	Yes	Varies	Yes	No	Varies
Two-aged clearcut	Lodgepole, Ponderosa, Mixed Conifer	Yes (even-aged)	Up to 90%	50-100%	n/a	Moderate -High	Yes	Varies	Yes	Yes	Varies
Two-aged coppice cut	Aspen	Yes (even-aged)	Up to 90%	50-100%	n/a	Moderate -High	Yes	Varies	Yes	Yes	Varies
Shelterwood/Intermediate/ Uneven-aged											
Shelterwood prep cut	All	Yes (even-aged)	Up to 40%	30-49%	n/a	Low-Moderate	Yes	Lop and Scatter	No	Yes	Possible
Shelterwood establishment cut	All	Yes (even-aged)	Up to 80%	30-49%	n/a	Low-Moderate	Yes	Lop and Scatter	No	Yes	Possible
Thinning	All	No	varies	30-49%	n/a	Low-Moderate	Not usually	Lop and Scatter	No	Not Usually	No
Sanitation	All	Not Usually but may occur	varies	30-49%	n/a	Low-Moderate	Not usually	Varies	No	Depends on % removal	Possible
Salvage	All	Not Usually but may occur	varies	30-49%	n/a	Low-Moderate	Not usually	Varies	No	Depends on % removal	Possible
Improvement cut	All	No	<30%	30-49%	n/a	Low-Moderate	Not usually	Varies	No	Not Usually	No
Liberation cut	All	No	Up to 100%	30-49%	n/a	Low-Moderate	Not usually	Varies	No	Not Usually	No
Release and weed	All	No	<30%	30-49%	n/a	Low-Moderate	Not usually	Varies	No	No	No
Non-stand replacing prescribed fire	All	Possible	<30%	30-49%	n/a	Low-Moderate	Not usually	n/a	No	Depends on % removal	Possible

Group selection	All	yes (uneven-aged)	100% in groups	30-49%	n/a	Low-Moderate	Varies	Varies	Yes	Not Usually	Possible
Single tree selection	All	yes (uneven-aged)	<30%	30-49%	n/a	Low-Moderate	Not usually	Lop and Scatter	Yes	Not Usually	Possible
Adaptive Mgmt. Treatment Option	**Tree Cover type Application**	**Regeneration Objective**	**% Overstory Removal**	**Current Mortality**	**CMAI**	**Current Insect and Disease level**	**Site Prep**	**Slash treatment**	**Regen Survey and Certification**	**Windthrow Concern**	**TSI Need**
Green tree/Shrub land and Grassland											
Conifer removal (from aspen, shrub land or meadows)	Aspen	No	Varies	n/a	n/a	n/a	No	Varies	No	Possible	No
Mountain shrub and sage brush treatment	N/A	Varies	n/a	n/a	n/a	n/a	Possible	Varies	No	No	No
Grass and forb treatment	N/A	Yes	n/a	n/a	n/a	n/a	Possible	n/a	No	No	No
Coppice cut	Aspen	Yes (even-aged)	Up to 100%	<30%	n/a	n/a	Varies	Varies	Yes	Possible	No
Two age Coppice cut	Aspen	Yes (even-aged)	Up to 90%	<30%	n/a	n/a	Varies	Varies	Yes	Possible	No
Shelterwood prep cut	All	Yes (even-aged)	Up to 40%	<30%	n/a	Low-Moderate	Yes	Lop and Scatter	No	Yes	
Shelterwood establishment cut	All	Yes (even-aged)	Up to 80%	<30%	n/a	Low-Moderate	Yes	Lop and Scatter	No	Yes	
Thinning	All	No	varies	< 30%	n/a	Low-Moderate	Not usually	Lop and Scatter	No	Not Usually	No
Sanitation	All	Not Usually but may occur	varies	< 30%	n/a	Low-Moderate	Not usually	Varies	No	Depends on % removal	Possible
Salvage	All	Not Usually but may occur	varies	< 30%	n/a	Low-Moderate	Not usually	Varies	No	Depends on % removal	Possible
Improvement cut	All	No	<30%	< 30%	n/a	Low-Moderate	Not usually	Varies	No	Not Usually	No
Liberation cut	All	No	Up to 100%	< 30%	n/a	Low-Moderate	Not usually	Varies	No	Not Usually	No
Release and weed	All	No	<30%	< 30%	n/a	Low-Moderate	Not usually	Varies	No	No	No
Non-stand replacing prescribed fire	All	Possible	<30%	< 30%	n/a	Low-Moderate	Not usually	n/a	No	Depends on % removal	Possible
Group selection	All	yes (uneven-aged)	100% in groups	< 30%	n/a	Low-Moderate	Varies	Varies	Yes	Not Usually	Possible
Single tree selection	All	yes (uneven-aged)	<30%	< 30%	n/a	Low-Moderate	Not usually	Lop and Scatter	Yes	Not Usually	Possible

Lodgepole Pine Cover type

Direct and Indirect Effects

Within the lodgepole pine cover type stand initiation treatments will be prescribed where stand conditions have 50% or greater mortality, and/or high levels of insect and diseases or stands have reached culmination of mean annual increment. Stand initiation treatments will result in high disturbance and be effective in putting stands with high mortality or insect and diseases back into production more rapidly than if treatments were not performed. Opening of the stand and scarification of the soil will create conditions which promote lodgepole pine regeneration (Figures 15a and b). A study that compared the density of seedlings between cut and uncut lodgepole pine stands found that there was almost 18 times the density of lodgepole pine regeneration after harvest in the cut areas as compared to uncut areas (Rhodes 2018). Also the greater amount of light that reaches the forest floor will discourage propagation of shade tolerant species such as subalpine fir (Collins 2010).

Prescribed burning standing dead lodgepole pine will most likely not consume all of the standing dead and weaken the base of the dead trees. This could result in standing dead falling and creating a heavy ground fuel load within treatment areas. In areas where lodgepole pine and aspen are intermixed the dead fall could create a natural barrier which could help prevent browsing of aspen regeneration. If down and dead fuels levels are unacceptable follow up treatments to reduce/remove the accumulated dead such as mechanical site prep may be necessary.

Within the lodgepole pine cover type shelterwood, intermediate or uneven-aged treatments will be conducted where stand conditions have 30-49% mortality, and/or low to moderate levels of insect and diseases. Shelterwood treatments result in 40% to 80% of the stand being removed and regeneration occurring. Regeneration results of this treatment can vary. In stands with less removal light conditions would favor regeneration of shade tolerant species, such as subalpine fir. Regeneration of shade intolerant species, lodgepole pine, would be favored in stands with higher percentages of removal. If the residual overstory is not removed stands would develop two distinct age classes. Intermediate treatments; thinning, sanitation, salvage, improvement and liberation cutting, and release and weed treatments; would increase the health and growth of the residual stand (Figures 15c and d). These treatments would result in a future forest with more available commercial products than untreated areas (Alexander 1980).

Within the lodgepole pine cover type green tree treatments will be conducted where stand conditions have less than 30% mortality and/or low to moderate levels of insect and diseases. The effects of green tree

Figure 15: Lodgepole Pine Cover Type Action Alterantive Treatment Examples

15(a) Lodgepole Pine Clearcut

15(b) Lodgepole Pine Overstory Removal

15(c) Lodgepole Pine Thinning (Mastication)

15(d) 15 years after Lodgepole Pine Pre-commercial Thinning

treatments are the same as those listed above for shelterwood, intermediate and uneven-aged treatments. Precommerical/commercial thinning conducted as an intermediate or green tree treatment, has a positive effect on diameter growth of the residual trees and accelerate the accumulation of merchantable volume. (Johnstone 2011) Thinning can also be used to move "stands out of closed-canopy stage and accelerate development of conditions found in late seral forests". (Sullivan 2006)

During activities both commercial and non-commercial products will be removed. Commercial volume from suitable timber lands will contribute to the Medicine Bow National Forest's allowable sale quantity (ASQ).

Engelmann Spruce/Subalpine Fir Cover type

Direct and Indirect Effects

Within the Engelmann spruce/subalpine fir cover type stand initiation treatments will be conducted where stand conditions have greater than 50% mortality, and/or high levels of insect and diseases. Stand initiation treatments within this cover type allowed by the Forest Plan are shelterwood and irregular shelterwood silviculture systems. Under a three step shelterwood system about 1/3 of the volume of the stand is remove in each step. In an irregular shelterwood system the final overstory removal is not completed and the overstory remains creating a two-storied or two aged stand. In some cases standing snags would remain to provide shelter for the developing understory. Removal of 1/3 of the volume of the stand would create shaded to partial shaded conditions suitable for regeneration of Engelmann spruce and subalpine fir (Figure 16a). Scarification of the soil during harvesting operations would create conditions favorable for germination of Engelmann spruce and subalpine fir (USDA 1990). If stands have more then 30-40% of the basal area removed they may succumb to windthrow (Alexander 1987). If stands are cut too heavy and the residual trees blow over establishment of spruce and fir seedlings may be difficult due to unfavorable microsite conditions.

Within the Engelmann spruce/subalpine fir cover type shelterwood, intermediate or uneven-aged treatments will be conducted where stand conditions have 30-49% mortality, and/or low to moderate levels of insect and diseases. Shelterwood treatments in these stand conditions would have similar effects to those listed in the stand initiation treatment types. Intermediate treatments; thinning, sanitation, salvage, improvement and liberation cutting, and release and weed treatments; would increase the health and growth of the residual stand (Figure 16b). These treatments would result in a future forest with more available commercial products than untreated areas (Alexander 1987).

Figure 16: Engelmann Spruce-Subalpine Fir Action Alternative Treatment Examples

Figure 16(a) Spruce shelterwood silvicultural system

Figure 16(b) Thinning Engelmann spruce and subalpine fir.

Figure 16(c) Group Selection cutting

Single tree selection and group selection silvicultural systems for this cover type are allowed under the Forest Plan. These systems would create or maintain uneven-aged stand characteristics. Single tree selection would harvest trees in several or all diameter classes on an individual tree basis found in a stand. This would create a stand with trees of varying size and age classes intermingled on the same site. Regeneration under this system would favor more shade tolerant subalpine fir over spruce (Alexander 1987). Single tree harvesting would keep forest cover over the entire stand with gaps occurring where medium and large sized trees were removed. Damage from harvesting operations is likely with damaged trees susceptible to insects and diseases. Group selection would harvest all the trees within a designated area, generally less than 2 acres in size (Figure 16c). This method essentially creates small groups of even-ages with multiple age groups within a stand. Group openings generally less than two times the height of mature trees result in favorable microsite conditions for Engelmann spruce regeneration (Windmuller-Campione 2015). If group sized become too large regeneration of Engelmann spruce and subalpine fir can be impacted. With group selection the stand maintains forest cover except for periods of time after group cuts are completed. Generally new groups are not cut until previously cut groups provide forested cover. Damage from harvesting operation is minimized as compared to single tree selection. Windmuller-Campione and Long (2015) say that resilience of Engelmann spruce stands (to spruce beetle) across the landscape is dependent upon natural regeneration and planting of Engelmann spruce. They suggest that vegetation management that encourages regeneration of Engelmann spruce will create a more resilient landscape.

Within the Engelmann spruce/subalpine fir cover type green tree treatments will be conducted where stand conditions have less than 30% mortality and/or low to moderate levels of insect and diseases. The effects of green tree treatments are the same as those listed above for shelterwood, intermediate and uneven-aged treatments. Pre-commercial and commercial thinning of spruce can increase volume production of residual trees. Also irregular thinning; variable density thinning, variable height thinning, etc.; can help develop stand structural heterogeneity (Gauthier 2015)

During activities both commercial and non-commercial products will be treated. Commercial volume from suitable timber lands will contribute to the Medicine Bow National Forest's allowable sale quantity (ASQ).

Aspen Cover type

Direct and Indirect Effects

Within the aspen cover type stand initiation treatments will be conducted where stand conditions have greater than 50% mortality, and/or high levels of insect and diseases. Stand initiation treatments will result in high disturbance and be effective at regenerating aspen clones. Opening of the stand and scarification of the soil will create conditions preferable to aspen suckering (Figures 18a and b). Aspen stands that are in advanced level of decay may not produce large number of suckers in response to stand initiation treatments (DeByle 1985). Two aged coppice cutting in which a small portion of the aspen stand remains after harvest can result in high levels of regeneration and a two aged structure. However partial cutting, leaving greater percentages of standing trees, may result in a decrease in the amount of regeneration and increase the possibility to damage residual trees (DeByle 1985).

Within the aspen cover type intermediate or uneven-aged treatments will be conducted where stand conditions have 30-49% mortality, and/or low to moderate levels of insect and diseases. Intermediate treatments; thinning, sanitation, salvage, improvement and liberation cutting, and release and weed treatments; would increase the health and growth of the residual stand. Damage to residual trees resulting increase in the presence of insects and disease and sunscald damage can result from intermediate treatments. Intermediate treatments in this cover type are not often prescribed in the intermountain west (DeByle 1985).

Within the aspen cover type green tree and conifer removal treatments will be conducted where stand conditions have less than 30% mortality and/or low to moderate levels of insect and diseases. The effects of green tree treatments are the same as those listed above for intermediate and uneven-aged treatments. Conifer removal treatments within aspen stands will most likely result in an increase of aspen regeneration due to soil disturbance and an increase in sunlight reaching the forest floor. During conifer removal treatments damage to residual trees could increase the presence of insects, disease, and sunscald damage.

At a localized level there is potential for the sprouting/suckering created by treatments to be browsed by ungulates which could cause damage and potentially lead to the loss of stands where aspen experience multiple disturbances in a short time period. To minimize the damage to aspen stands and the risk of losing large areas of aspen, treatment areas would be large and spread out across the landscape to reduce the effects of browsing by ungulates. Where appropriate methods to reduce browsing damage such as, fencing and/or leaving high slash levels within stands, could be applied.

Figure 17: Aspen Cover Type Treatment Examples

Figure 18(a) Coppice cut

Figure 18(b) Two aged coppice regeneration

Figure 18(c) Conifer removal

This increase in regeneration will create structural diversity of aspen at the stand and landscape level. Aspen stands within or adjacent to conifer treatment units will see an increase in clone growth and size growth due to disturbance from the treatments and an increase in sunlight reaching the forest floor.

Fire

Stand replacing prescribed fire kills all or most of the living canopy (in a forest or woodland, trees) producing a full exposed microclimate and initiates succession or regrowth. Within the lodgepole pine cover type stand replacing prescribed fire would remove the majority of the overstory canopy, allowing more light to reach the forest floor, and expose mineral soil creating conditions favorable for lodgepole pine regeneration. Within the aspen cover type stand replacing prescribed fire would disturb the stand killing the overstory and stimulate suckering (DeByle 1985). Within the Engelmann spruce/fir cover type stand replacing prescribed fire is not recommended as a severe fire could transition stands to a subalpine grassland or aspen type resulting in a slow recovery to a spruce-fir climax community (Alexander 1987). Within the spruce/fir cover type this type of prescribed fire would have to be carefully managed to emulate a shelterwood silviculture system as allowed by the Forest Plan.

Non-stand replacing prescribed fire treatments; broadcast burning and jackpot burning; produce highly variable results. These types of burning are design to remove forest floor residue and understory canopy while leaving the overstory canopy mostly intact. Jackpot burning would remove piled or accumulated forest floor residue while having minimal impact on the overstory canopy. Some understory and overstory canopy will most likely be consumed or experience mortally from these burns. Broadcast burning would also remove forest floor residue but would have a greater impact on the understory and overstory canopy. Jackpot burning usually results in a mosaic burn pattern where broadcast burning affects the majority of the vegetation within the treatment area. Removal of forest residue could create conditions suitable for regeneration of tree species, increase herbaceous growth, remove ladder fuels, and open canopy conditions. Low to moderate levels of tree mortality from prescribed burning is anticipated. This mortality will free up resources; light, water and nutrients; creating conditions in which reaming trees could experience an increase in growth. Areas of high tree mortality may occur. Small areas of high mortality could

Figure 18: Fire Effects by Cover Type

Figure 18(a) Stand replacing fire in lodgepole pine

Figure 18(b) Regeneration of aspen 3 years post stand replacing fire

Figure 18(c) Low intensity burn after vegetation management in lodgepole pine and mixed conifer.

Figure 18(d) Low intensity fire in mixed conifer

result in patches of even-aged regeneration there by creating an uneven-aged stand. Large areas of high mortality would return the stand to the stand initiation stage.

Slash treatment

A variety of slash treatments will be applied throughout implementation of the Lava project. For all treatment types slash treatments may include: prescribed burning, lop and scatter, machine/hand pile and burn, mastication, machine trampling or roller chopping. Slash treatments will be determined before or post-harvest/vegetation management based upon ground conditions, silvicultural and other objectives of the treatment. Within identified WUI areas or areas that have a fire concern most slash will be removed from the unit either by harvesting techniques, such as whole tree skidding, mastication, or be piled following vegetation treatment for later burning. Slash treatment outside of fire concern areas will often leave most of the slash in treatment areas. Within these treatment areas slash could be lopped and scattered, machine trampled, roller chopped or other method that leaves slash in place but condensed by hand or mechanized equipment. Leaving slash in place can increase favorable microsite conditions for regeneration of tree species, increase nutrient cycling, reduce sediment transportation, increase soil moisture and address other resource concerns.

Figure 19: Slash Treament Types

Figure 19(a) Pile burning under a canopy

Figure 19(b) Lop and scatter treatment

Figure 19(c) Roller chopping slash

Figure 19(d) Mastication in lodgepole pine

Old Growth

Spies and Franklin state that "Old growth cannot be maintained without a patch dynamics (landscape) perspective. The rates and sizes of disturbances will determine potential types of old growth in an area. Sustaining elements of biological diversity associated with old growth can be facilitated by: (1) maintaining current areas of old growth; (2) providing areas for replacement of old growth lost to disturbances; (3) facilitating organism dispersal among old-growth areas in landscapes; (4) providing old-growth habitat elements in managed forests; and (5) using manipulations to reduce the time needed to develop old-growth characteristics." (Spies 1996) Treatments under the Lava project address points 1, 2, 4 and 5. Vegetation treatments in designated old growth will be conducted to maintain characteristic of old growth by using appropriate silvicultural systems, such as individual tree selection. When treatments are proposed in designated old growth but are no longer functioning as old growth selection of new areas that have characteristics of old growth will be delineated; point 2. Silvicultural practices that leave or create structural elements of

old growth; irregular shelterwood, green and dead tree retention, and thinning in a patchy manner to release younger trees can be applied; point 4 and 5. No treatment of designated old growth is also an option; point 1. Treatments applied in these manners will facilitate the maintenance or enhancement of old growth within the Lava project.

Cumulative Effects: Proposed Action

The combination of vegetation treatments, bark beetles, and other insects and disease effects across the project areas will result in a variety of stand structures. Implemented stand initiation treatments in conjunction with tree mortality will move habitat structural stages from mid and late seral, HSS3 and 4, to structural stage 1 or 2. This conversion to a more early seral structure stage will move forest structure closer to the identify Forest Plan 50 year desired conditions. Implemented intermediate and uneven-aged treatments will create favorable growing conditions for residual trees which could move stands into larger size classes and develop characteristics of mid and late serial structural stages. In combination the proposed treatment categories in the Lava project will increase structural diversity at the landscape scale and at the stand scale when uneven-aged treatments are applied. Varying size of treatments from large areas; stands with high mortality and/or moderate to high insect and disease levels; to small areas; stands with low mortality and/or low to moderate insect and disease levels; will also increase the structural diversity of the landscape. By increasing the structural diversity at the stand and landscape scale resilience to disturbance can be increase (Seidl 2015).

The overlapping disturbance of bark beetle mortality, vegetation management and fire can have varying effects in the lodgepole pine cover type. Rhoades et al found that in areas of overlapping disturbance of salvage logging and fire, post fire conifer recruitment was diminished as compared to areas that did not have the overlapping disturbances (Rhoades 2018). This is due to loss of seed source from beetle mortality of non-serotinous cone lodgepole, serotinous cone lodgepole releasing seed due to heating of exposed cones on tree limbs, removal of live mature cone bearing lodgepole pine and burning of the seed stored in the logging slash and duff layer during fire events.

COMPLIANCE WITH REGULATORY DIRECTION

The Proposed Action alternative is consistent with the Forest Plan direction for the timber resource. The no action alternative is consistent with all Forest-Wide Standards for Vegetation except: (MA 5.15) Manage vegetation to maintain or restore healthy ecological conditions through a variety of management activities. Timber harvest is scheduled and does contribute to the allowable sale quantity. There are opportunities to collect firewood. The no action alternative is inconsistent with Forest Plan Guidelines: (MA 1.31, 1.33) Allow the cutting or removal of trees under circumstances such as; to reduce fuel load and fire risk, especially adjacent to private land; to curtail imminent threat of insect attack; enhancing a scenic view from a prominent overlook, to maintain wildlife habitat diversity or maintenance of existing facilities; (MA 5.13) Manage stands using treatments, which maintain acceptable rates of growth as well as favor commercially valuable tree species; Use a full range of biologically appropriate silvicultural practices to produce sawtimber and other forest products; (MA 8.6) Vegetation should be managed to reduce the risk of loss to administrative facilities from catastrophic fires.

A Forest Plan amendment would not be required to ensure project consistency with existing 2003 Forest Plan Direction for silviculture. Applicable Forest Plan Standards and Guides are provided above.

Alternative Comparison

Table 15: Most Likely Response and Treatment Types by Alternative and Cover Type

	No Action				Action			
	Cover type				Cover type			
Analysis Unit	**LP**	**SF**	**AS**	**Other**	**LP**	**SF**	**AS**	**Other**
BattlePass	NC, SF	NC, SF	NC, SF	NC, SF	IT	UA, IT	SI, GA, IT	MS
BigBlackhall	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	IT	SI, GA, IT	MS
BowKettle	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	UA, IT	SI, GA, IT	
CedarBrush	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	UA, IT	SI, GA, IT	
FoxWood	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	IT	IT	MS
FrenchDouglas	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	UA, IT	IT	
GreenHog	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	IT	SI, GA, IT	MS
JackSavery	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	UA, IT	SI, GA, IT	MS
NorthCorner	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	UA, IT	IT	
OwenSheep	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	IT	SI, IT	MS
PeltonPlatte	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	IT	IT	MS
RockMorgan	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	UA, IT	IT	
SandyBattle	NC, SF	NC, SF	NC, SF	NC, SF	IT	IT	SI, GA, IT	MS
WestFrench	NC, SF	NC, SF	NC, SF	NC, SF	SI, IT	UA, IT	SI, GA, IT	

NC	no change/ natural processes
SF	increase in subalpine fir/ conifer encroachment likely
SI	stand initiation treatments likely
UA	uneven-aged treatments likely
IT	intermediate treatments likely
GA	green/aspen tree treatments likely
MS	meadow/shrublands treatments likely

Table 15 shows under the No Action alternative natural processes and a potential increase in abundance of subalpine fir is likely for all cover types. For the Action alternative the most likely treatment type by cover type are listed. This is not a limit on what types of treatments could occur in each analysis unit. Most likely treatment types by analysis unit are listed based upon the amount of cover type within an analysis unit. For example the Foxwood analysis unit is primarily composed of lodgepole pine, grass and shrublands therefore the most likely treatments are stand initiation in lodgepole pine cover types and meadow and shrublands treatments. However due to a small amount of spruce fir cover type within the analysis unit uneven-aged treatments are unlikely. Intermediate treatments are likely in all cover types.

Under the No Action alternative multiple opportunities for beneficial action will be missed if management actions are not taken. Specific effects to the timber resource include

- Loss of timber production
- Slow break-up of beetle killed lodgepole stands resulting in a loss in growth
- Reduction in the regeneration of lodgepole pine seedlings
- Reduction in the ability to manage commercially viable species now and in the future
- Change in species composition to a greater percentage of subalpine fir
- Potential increase in dwarf mistletoe
- Potential increase in the loss of seed source

Under the Proposed Actin Alternative Multiple opportunities for beneficial action exist. Specific effect to the timber resource include.

- More favorable conditions for regeneration of commercially viable trees
- Lodgepole pine stands returned to commercial production more rapidly than under the no action alternative
- Reduced competition and stress on remaining trees as a result of thinning operations
- Potential increase in forest regeneration as a result of scarification of the soil and opening of stands
- Higher occurrence of aspen regeneration as a result of treatments
- Potential reduction in the presence of dwarf mistletoe

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Silvicultural Findings of Compliance with Laws, Regulations, and Policy: Landscape Vegetation Analysis Project

The following findings are made based on the environmental analysis and the silvicultural prescription:

Consistency [36 CFR 219.8(e)]:

1. *Timber harvest would occur on lands suited for timber production or would occur in areas where timber harvest is permitted and is necessary to help achieve other resource management objectives; and*

Timber harvest will occur on not suitable lands to meet the purpose of the project to:

- Improve wildlife habitat for a wide range of species;
- Improve range conditions for big game winter habitat and domestic livestock;
- Create a mosaic of species and age class diversity across the project area;
- Decrease fuel loading and the likelihood of higher severity wildland fires;
- Increase the resiliency of native vegetation.

Management Areas and Themes within the LAVA Project Area	Acres within the Project Area
1.13 Wilderness, 1.2 Recommended Wilderness, 2.2 Research Natural Areas	109,294
5.13 Forest Product, 5.15 Forest Products, Ecological Maintenance and Restoration Considering the Historic Range of Variability	413,885

All other MAs: 1.31. 1.33, 2.1, 3.31, 3.33, 3.4, 3.5, 3.54, 3.56, 3.58, 4.2, 4.3, 5.12, 5.41, 8.21, 8.22, 8.6	325,536

2. *Silvicultural treatments are consistent with the Forest Plan.*

Appropriate silvicultural systems by forest cover type will be: <u>Cover Type Silvicultural System</u> Ponderosa Pine/ Mixed Conifer: Shelterwood, Clearcut, Seed tree, Irregular Shelterwood, Group Selection, Single-tree selection Lodgepole pine: Clearcut, Shelterwood, Group Selection, Seed tree, Irregular Shelterwood Engelmann Spruce / Subalpine Fir: Shelterwood, irregular Shelterwood Group Selection, Single-tree Selection Aspen with Standards: Coppice, Coppice Group Selection **(Standard 2,p. 1-36)**	When implemented vegetation treatments will abide by the appropriate silvicultural systems for each cover type as described in the Forest Plan. Complies with Forest Plan Standards and Guides.

Multiple silvicultural systems will be used during this project including even-aged systems. Even-aged systems used during this project meet Forest Plan objectives and requirements (see Forest-Wide Standards and Guidelines for Vegetation pg. 8)

Timber Harvest [16 U.S.C. 1604 (g)(3)(E)]:

1. *Soil, slope, or other watershed conditions will not be irreversibly damaged;*

Reference Landscape Vegetation Analysis Project Watershed Specialist Report and Assessment of the Soil Resource report.

2. There is assurance that the lands can be adequately restocked within five years after final regeneration harvest;

Stocking surveys would be completed at the 3rd and 5th year to monitor stocking of natural regeneration. Certification of stocking levels of natural regeneration will be after the 3rd or 5th year if levels meet forest plan standards. If natural regeneration does not meet stocking standards stocking levels could be augmented through planting. Assurance is based on the assumption that funding will be available. Events such as high intensity fires may alter site conditions such that Forest Plan stocking objectives may be inappropriate.

3. Streams, streambanks, shorelines, lakes, wetlands, and other bodies of water are protected from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment where harvests are likely to seriously and adversely affect water conditions or fish habitat; and

Reference Landscape Vegetation Analysis Project Watershed Specialist Report and Fisheries, Amphibians and Aquatic Habitat Specialist Report

4. The harvesting system to be used was not selected primarily because it will give the greatest dollar return or the greatest unit output of timber.

Even-aged Regeneration Harvests [16 U.S.C. 1604 (g)(3)(F)]:

1. For clearcutting, it is the optimum method;

Clearcut harvest method or the end appearance of a clearcut in several treatment types may occur due to stand conditions from bark beetle mortality. In some stands potential residual trees would be damaged by harvest activities or would be likely to become windthrown due to the opening of the stand.

2. Clearcuts, coppice cuts, seed tree, and shelterwood regeneration harvests are appropriate to meeting the objectives and requirements of the Forest Plan;

Silvicultural systems proposed for this project are consistent with the Forest Plan (#2 above)

3. An interdisciplinary review was completed and the potential environmental, biological, aesthetic, engineering, and economic impacts were assessed and the cutting methods are consistent with the multiple use of the project area;

The Landscape Vegetation Analysis Project environmental assessment was completed for this project.

4. Cut blocks, patches, or strips are shaped and blended to the extent practicable with the natural terrain;

The design of the units in irregular shapes and sizes imitates characteristics of natural disturbances. Units shaped with non-linear boundaries will increase the edge to interior ratio.

5. Even-aged regeneration harvests made in one operation meet the 40-acre maximum size limit requirement; and

Due to the Bark Beetle epidemics openings greater than 40 acres may be created, as allowed for under Silviculture Standard 1b (p1-35) of the Forest Plan.

6. Harvest will be consistent with the protection of soil, watershed, fish, wildlife, recreation, esthetic resources, cultural and historic resources, and the regeneration of timber resources.

Reference Landscape Vegetation Analysis Project Watershed Specialist Report; Fisheries, Amphibians and Aquatic Habitat Specialist Report; Wildlife Specialist Report for Terrestrial Wildlife Resources; Recreation, Lands, Special Uses and Wilderness Input; Heritage Resource Specialist Report; and the Silviculture Specialist's Report.

Culmination of Mean Annual Increment [16 U.S.C. 1604 (m)]:

Stands of trees harvested have generally reached the culmination of mean annual increment of growth (CMAI).

Stands may not have reached 95% of CMAI. These harvests fall under the exemptions:

a. Stands that are in imminent danger from insect or disease attack/mortality;

f. Other management objectives; The CMAI requirement does not apply to thinning, salvage, or sanitation harvests or to harvests designed to achieve non-timber resource objectives such as fuels reduction in wildland urban interface areas. (FSM 1921.12f).

Findings prepared by: Tim Douville Date: 3/23/2018

Findings recommended by: Tim Douville Date: 3/23/2018

(Certified silviculturist)

Findings accepted by: Date:

(line officer)